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1 INTRODUCTION

In the process of understanding and developing models for geomaterials, the stress-strain behaviour is commonly studied by performing triaxial tests. In the present study, several types of static triaxial tests have been performed to gain knowledge of the undrained stress-strain behaviour of frictional materials during monotonic loading. The tests conducted includes undrained and constant volume tests, starting from different initial states of stress and following various stress paths.

All the tests are performed on reconstituted loose to medium dense specimens of Eastern Scheldt Sand. Soil properties and test procedures are described in the succeeding sections, ending with a summary of the performed triaxial tests.

For information about the hydraulic properties, drained and cyclic loading response of Eastern Scheldt Sand please refer to Jakobsen (1998a), Jakobsen and Praastrup (1998) and Jakobsen (1998b), respectively.

2 EASTERN SCHELDT SAND

Eastern Scheldt Sand is a fine, well-sorted line shore quartz sand, with sub-rounded to rounded grains. The classification properties are summarised in Table 1. For further information about grain size distributions refer to Jakobsen (1998a).

Table 1. Classification properties for Eastern Scheldt Sand.

Property	Value
Specific gravity, G_s	2.650
Maximum void ratio, e_{max}	0.886
Minimum void ratio, e_{min}	0.591
Maximum grain size, d_{100}	0.500 mm
Mean grain size, d_{50}	0.166 mm
Fines content	1.3 %
Uniformity coefficient, $C_U = \frac{d_{60}}{d_{10}}$	1.52
Curvature coefficient, $C = \frac{d_{30}^2}{d_{10} d_{60}}$	0.99

3 EQUIPMENT FOR STATIC TRIAXIAL TESTING

During the triaxial test axial load and deformation, volume changes as well as pore and cell pressures are electronically measured and transmitted to the computer for data processing and actuation of cell pressure or axial load adjustments, allowing any stress path to be followed. The triaxial tests can be conducted with

or without backpressure. Further information about the used equipment and its capabilities are found in Jakobsen and Praastrup (1998).

In order to avoid measuring errors due to false deformations of the apparatus, all measurements are performed as close to the specimen as possible. Thus, displacement transducers are mounted on the top and bottom pressure heads, the axial load is measured inside the cell and the pore pressure is measured in the bottom pressure head beneath the porous filter.

The traditional undrained (CU) or constant volume ($CU_{u=0}$) tests are performed by use of two different concepts. In the traditional undrained test, backpressure is applied to ensure a high degree of saturation before the drainage lines are closed (see Section 4.1). The backpressure is crucial for the undrained test as the inherent constant volume only exists for completely saturated soils. The constant volume condition might nevertheless be violated as the soil tends to dilate during shear, resulting in decreasing pore pressure and unintended release of dissolved gases.

Alternatively the volume of the specimen can be held constant by adjusting the cell pressure to ensure that no water enters or leaves the specimen. This procedure ($CU_{u=0}$) is performed with zero pore pressure change, preventing any change in the degree of saturation.

Besides the difference in testing techniques there is a distinct difference in the way the measured data are analysed. In the CU-test the effective stress path is deduced from the knowledge of cell pressure and developed pore pressure during shear. In the $CU_{u=0}$-test the effective stress path is followed throughout the test and the pore pressure response equals the change in confining pressure.

4 SPECIMEN PREPARATION

As described in the companion report, Jakobsen and Praastrup (1998), it is of great importance to ensure a homogenous stress and strain state inside the specimen. Consequently, the major parts of the tests are performed on 70×70 mm specimens using lubricated end plates (Jacobsen, 1970; Rowe and Barden, 1964; Kirkpatrick, 1974). The effect of inhomogenous stress and strain states on the undrained soil response is revealed by execution of a few tests on 140×70 mm specimens.

All the specimens are prepared by air pluviation in a split mould. In cases where the objective is to investigate the effect of pressure and stress path dependency the specimens are prepared with a tolerance on the initial void ratio of ± 0.001.

4.1 Specimen Saturation

Specimen saturation plays an important role in the study of the undrained behaviour of geomaterials. To obtain reliable measurements of development of pore pressure during testing, a high degree of saturation is necessary. The development of pore pressure during an undrained triaxial test, simulating the condition of no volume change, depends on the resistance by the pore fluids to the tendency for volume change of the soil skeleton. The effect of insufficient saturation is most pronounced in this type of test, as the compressibility of the pore fluid is dominated by the free air. Thus, the free air will cause a violation of the no volume change condition and affect the magnitude of pore pressure developed. The specimen saturation is performed in one of two ways, depending on the type of test. For $CU_{u=0}$-tests the water percolation procedure is used for specimen saturation (please refer to Jakobsen and Praastrup (1998)), whereas specimens for CU-tests are saturated using backpressure.

4.1.1 Saturation using backpressure

Traditional undrained tests (CU) are performed with backpressure. The specimen is first flushed with carbon dioxide (CO_2) through the bottom drain replacing the lighter air. Deaired and deionized water is then introduced through the bottom drain and as the water seeps up through the specimen the carbon dioxide is partly pushed out and partly dissolved into the water. A positive effective confining pressure of 20 kPa is maintained throughout the saturation process. The backpressure is finally applied to force the carbon dioxide and eventual free air to dissolve completely into the water. The degree of saturation is afterwards checked by measuring the pore pressure coefficient, B, expressing the ratio between the resulting change in pore pressure and the imposed change in the cell pressure (Skempton, 1954). The pore pressure coefficient is strongly dependent on the degree of saturation and whereas a value of unity typically is interpreted as complete saturation, lower values may be indicative of incomplete saturation. Factors like the compressibility and porosity of the soil skeleton and membrane penetration may, however, affect the measured value in both downward and upward directions (Kiekbusch and Schuppener, 1977; Martin et al. 1978).

5 PERFORMED TRIAXIAL TESTS

After saturation the specimen is isotropically consolidated at a maximum loading rate of 5-10 kPa per minute, and afterwards sheared at a maximum axial strain rate of 3 % per hour.

The test conditions for the performed $CU_{u=0}$ and CU triaxial tests are summarised in Tables 2 and 3, respectively.

6 PRESENTATION OF TEST RESULTS

The analysis of the test results is briefly discussed and parameters used for description of characteristic stress and strain states are defined in the following.

During the triaxial test simultaneous values of axial displacement, volume change, confining pressure, pore pressure and axial load are measured by the principles outlined in Section

Table 2. Initial conditions for constant volume triaxial tests ($CU_{u=0}$).

Test No.	e_0 [-]	p'_0 [kPa]	Total stress path	Note
9710.09	0.671	80.0	$\Delta q/\Delta p = 3$	
9710.10	0.670	640.0	$\Delta q/\Delta p = 3$	
9710.11	0.671	40.0	$\Delta q/\Delta p = 3$	
9710.19	0.673	320.0	$\Delta q/\Delta p = 3$	
9710.20	0.671	160.0	$\Delta q/\Delta p = 3$	
9710.31	0.672	160.0	$\Delta q/\Delta p = 3$	
9710.39	0.673	160.0	$\Delta q/\Delta p = 3$	
9710.40	0.825	160.0	$\Delta q/\Delta p = 3$	
9710.41	0.824	320.0	$\Delta q/\Delta p = 3$	
9710.42	0.825	640.0	$\Delta q/\Delta p = 3$	
9710.43	0.825	960.0	$\Delta q/\Delta p = 3$	Control system temporarily out of order
9710.44	0.825	960.0	$\Delta q/\Delta p = 3$	
9710.45	0.726	640.0	$\Delta q/\Delta p = 3$	
9710.46	0.881	640.0	$\Delta q/\Delta p = 3$	
9710.47	0.770	640.0	$\Delta q/\Delta p = 3$	
9710.48	0.825	640.0	$\Delta q/\Delta p = 3$	Height to diameter ratio equal to 2
9710.49	0.826	960.0	$\Delta q/\Delta p = 3$	Height to diameter ratio equal to 2

Table 3. Initial conditions for undrained triaxial tests (CU).

Test No.	e_o [-]	p_0' [kPa]	Total stress path	Note
9710.26	0.671	271.8	$\Delta p = 0$	Drainage valve opened at u = 0
9710.27	0.669	494.2	$\Delta q/\Delta p = -1.5$	
9710.28	0.670	104.3	$\Delta q/\Delta p = 2$	Drainage valve opened at u = 0
9710.29	0.633	104.3	$\Delta q/\Delta p = 2$	Wrong void ratio

3. As both the measured loads and displacements coincide with the principal axes of stresses and strains the analysis is straight forward. The exact displacement field is established from the measured axial displacements and the volumetric change. From these quantities the radial displacement is determined by the relation:

$$u_2 = \frac{D_0}{2} - \sqrt{\frac{V_0 - \Delta V}{\pi(H_0 - u_1)}} \quad (1)$$

u_1 being the average value of the measured axial displacements and $V_0 - \Delta V$ the current volume of the specimen. The relative deformation can afterwards be expressed by any suitable strain measure. In geotechnical engineering or geomechanics it is common practice to use the simple and linear engineering strain measure. This measure is, however found to be inconsistent with the used measuring techniques and may lead to erroneous results (Praastrup et al. 1998). It is therefore chosen to use the non-linear natural strain measure instead:

$$\varepsilon_1 = \ln\left(\frac{H_0}{H_0 - u_1}\right) \quad (2)$$

$$\varepsilon_2 = \varepsilon_3 = \ln\left(\frac{D_0}{D_0 - 2u_2}\right) \quad (3)$$

$$\varepsilon_v = \varepsilon_1 + 2\varepsilon_3 = \ln\left(\frac{V_0}{V_0 - \Delta V}\right) \quad (4)$$

The stresses are given as true stresses, expressing the ratio between current load and current area. The cross sectional area of the specimen is continuously corrected by:

$$A = \tfrac{\pi}{4}(D_0 - 2u_2)^2 = \frac{V_0 - \Delta V}{H_0 - u_1} \quad (5)$$

The test results are presented in terms of the deviatoric stress q and mean normal stress p':

$$p' = \tfrac{1}{3}(\sigma_1' + 2\sigma_3') = \tfrac{1}{3}((\sigma_1 - u) + 2(\sigma_3 - u)) \quad (6)$$

$$q = (\sigma_1' - \sigma_3') = (\sigma_1 - \sigma_3) \quad (7)$$

in which primes denote effective stresses. The corresponding work conjugate strains are the volumetric strain ε_v and the shear strain ε_q:

$$\varepsilon_v = \varepsilon_1 + 2\varepsilon_3 \quad (8)$$

$$\varepsilon_q = \tfrac{2}{3}(\varepsilon_1 - \varepsilon_3) \quad (9)$$

In addition to the presentation in terms of stresses and strains the stress states corresponding to minimum mean stress and maximum pore pressure, are also given in terms of angles. The angles are determined from the linear Coulomb friction hypothesis:

$$q = \frac{6\sin\varphi'}{3 - \sin\varphi'} p' \quad (10)$$

7 SUMMARY OF TEST RESULTS

Results of isotropic and anisotropic steps are summarised in Tables 4 and 5. Mean stress, axial and volumetric strain and void ratio are given for the isotropic compression step. For the undrained and constant volume steps the stress and strain states corresponding to the state of minimum mean stress and maximum pore pressure are given.

The graphical representation of the tests is found in Enclosure 1 to 21. Each enclosure consists of 4 to 5 pages, depending on the number of load steps. The first one or two pages contain information about test conditions, test program and a brief summary of the observed soil behaviour, i.e. minimum mean stress, maximum pore pressure and elastic properties if unloading have been performed. The final three pages contain the graphical presentation divided in total stress and strain paths and stress and strain paths for isotropic and anisotropic loading, respectively.

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Table 4. Results from $CU_{u=0}$ tests on Eastern Scheldt Sand.

		Isotropic compression				Constant volume compression											
						Minimum mean stress						Maximum pore pressure					
Test No.	Total stress path	p' [kPa]	ε_1 [%]	ε_v [%]	e [-]	σ'_3 [kPa]	u [kPa]	p' [kPa]	q [kPa]	ε_1 [%]	φ' [°]	σ'_3 [kPa]	u [kPa]	p' [kPa]	q [kPa]	ε_1 [%]	φ' [°]
9710.11	$\Delta q/\Delta p = 3$	40.4	0.02	0.10	0.669	22.6	17.5	34.8	36.9	0.13	26.7	21.4	18.6	37.8	49.0	0.25	32.2
9710.09	$\Delta q/\Delta p = 3$	80.5	0.10	0.25	0.667	43.0	37.1	67.0	72.1	0.28	27.1	40.7	39.4	70.7	90.2	0.42	31.7
9710.20	$\Delta q/\Delta p = 3$	160.5	0.18	0.57	0.661	88.5	71.7	133.7	135.6	0.41	25.7	84.8	75.3	138.4	160.8	0.54	29.1
9710.31	$\Delta q/\Delta p = 3$	160.5	0.15	0.48	0.664	86.9	73.2	130.0	129.3	0.44	25.2	84.5	75.6	134.0	148.6	0.59	27.9
9710.39	$\Delta q/\Delta p = 3$	160.5	0.13	0.44	0.666	89.8	69.3	134.9	135.1	0.58	25.4	86.3	72.8	139.5	159.5	0.75	28.7
9710.19	$\Delta q/\Delta p = 3$	320.4	0.24	0.84	0.659	173.3	146.6	263.9	271.8	0.53	26.1	163.8	156.1	272.2	324.9	0.74	29.9
9710.10	$\Delta q/\Delta p = 3$	640.1	0.43	1.26	0.649	300.1	339.9	470.6	511.6	1.10	27.4	288.9	351.1	480.9	575.9	1.33	30.0
9710.40	$\Delta q/\Delta p = 3$	160.5	0.24	0.56	0.815	54.0	106.0	83.6	88.8	1.13	26.8	53.4	106.6	85.5	96.4	1.41	28.3
9710.41	$\Delta q/\Delta p = 3$	320.5	0.39	1.23	0.802	103.0	217.1	163.9	182.7	1.99	28.0	102.0	218.1	164.5	187.4	2.17	28.6
9710.42	$\Delta q/\Delta p = 3$	640.7	0.60	1.70	0.794	204.8	435.4	323.4	355.7	3.01	27.7	202.8	437.4	328.3	376.6	3.53	28.8
9710.43	$\Delta q/\Delta p = 3$	960.4	0.40	2.09	0.787							273.1	686.9	449.1	528.2	3.92	29.5
9710.44	$\Delta q/\Delta p = 3$	960.4	0.59	2.02	0.788	263.3	696.7	426.4	489.3	3.50	28.8	260.8	699.2	429.3	505.5	3.94	29.5
9710.45	$\Delta q/\Delta p = 3$	640.3	0.51	1.32	0.703	274.1	365.9	429.3	465.7	1.93	27.3	268.5	371.4	432.7	492.6	2.22	28.6
9710.46	$\Delta q/\Delta p = 3$	640.5	0.73	1.86	0.846	188.8	451.1	292.5	311.0	2.91	26.9	185.6	454.3	293.9	325.1	3.41	27.8
9710.47	$\Delta q/\Delta p = 3$	640.5	0.47	1.52	0.744	227.8	411.1	362.3	403.7	2.29	28.0	223.9	414.9	366.0	426.3	2.65	29.2
9710.48	$\Delta q/\Delta p = 3$	640.5	0.47	1.76	0.793	158.0	482.0	258.2	300.6	2.82	29.2	157.2	482.8	259.7	307.5	3.09	29.6
9710.49	$\Delta q/\Delta p = 3$	960.3	0.68	2.36	0.783	190.5	769.4	317.6	381.4	3.74	30.0	189.2	770.7	318.6	388.3	4.11	30.4

Table 5. Results from CU tests on Eastern Scheldt Sand.

		Isotropic compression				Undrained compression														
						Minimum mean stress							Maximum pore pressure							
Test No.	Total stress path	p' [kPa]	ε_1 [%]	ε_v [%]	e [-]	σ'_3 [kPa]	u [kPa]	p' [kPa]	q [kPa]	ε_1 [%]	φ' [°]	σ'_3 [kPa]	u [kPa]	p' [kPa]	q [kPa]	ε_1 [%]	φ' [°]			
9710.26	$\Delta p = 0$	272.1	0.23	0.36	0.666	147.2	55.1	216.7	208.5	0.67	24.5	147.2	55.1	216.2	208.5	0.67	24.5			
9710.27	$\Delta q/\Delta p = -1.5$	494.7	0.47	0.58	0.659	231.7	-105.7	353.9	366.6	1.11	26.2									
9710.28	$\Delta q/\Delta p = 2$	104.8	0.13	0.18	0.667	53.5	66.3	84.7	93.6	0.37	27.8	52.9	72.9	96.3	130.1	0.67	33.5			
9710.29	$\Delta q/\Delta p = 2$	104.7	0.13	0.17	0.630	58.6	60.2	87.8	87.7	0.35	25.4	59.1	67.2	103.7	133.7	0.67	32.0			

9 NOTATION

A	[mm^2]	: area of specimen
B	[-]	: Skemptons pore pressure parameter
C	[-]	: curvature coefficient
C_U	[-]	: uniformity coefficient
d	[mm]	: grain size
D_0	[mm]	: initial diameter of specimen
e	[-]	: void ratio
e_0	[-]	: initial void ratio
e_{max}	[-]	: maximum void ratio
e_{min}	[-]	: minimum void ratio
E	[kPa]	: Young's modulus
G_s	[-]	: specific gravity
G	[kPa]	: shear modulus
H_0	[mm]	: initial height of specimen
p'	[kPa]	: mean normal stress (effective)
p'_0	[kPa]	: initial mean normal stress (effective)
q	[kPa]	: deviator stress
u	[kPa]	: pore pressure
u_i	[mm]	: principal displacements, i=1..3
V_0	[mm^3]	: initial volume
ε_q	[%]	: triaxial shear strain
ε_v	[%]	: triaxial volumetric strain
ε_i	[%]	: principal strains, i=1..3
σ'_3	[kPa]	: confining pressure (effective)
σ'_i	[kPa]	: principal stresses (effective), i=1..3
φ'	[°]	: effective friction angle

Enclosures

$CU_{u=0}$ Triaxial Test No. 9710.09

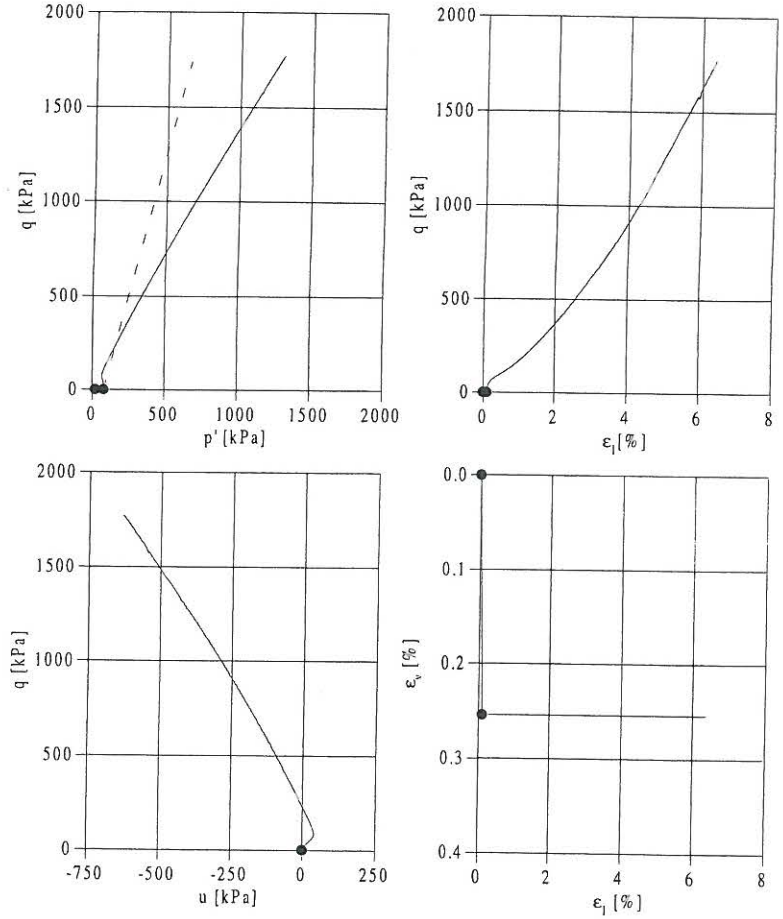
Description of soil Eastern Scheldt Sand	Triaxial Apparatus No. 2	Specimen properties
Specimen preparation Air pluviation	Calibration file Cal97101.dat	Height 71.48 mm Diameter 69.68 mm
Saturation procedure Water percolation	Date 1998-02-02	Void ratio 0.671

Test program	Isotropic compression, σ'_3 :	20.0 - 80.0	kPa
	Loading rate:	2.5	kPa/min
	Undrained compression Deformation rate:	3.0	% ph.

Isotropic compression			
Confining pressure	σ'_3	80.1	kPa
Axial strain	ε_1	0.10	%
Volumetric strain	ε_v	0.25	%
Void ratio	e	0.667	

Undrained compression		Values at p'_{min}		Values at u_{max}	
Stress ratio	σ'_1/σ'_3	2.68		3.22	
Confining pressure	σ'_3	43.0	kPa	40.7	kPa
Pore pressure	u	37.1	kPa	39.4	kPa
Deviator stress	q	72.1	kPa	90.2	kPa
Mean normal stress	p'	67.0	kPa	70.7	kPa
Ratio	q / p'	1.08		1.28	
Axial strain	ε_1	0.28	%	0.42	%
Friction angle	φ'	27.1	°	31.7	°

Job: Ph.D. Project	Aalborg University
Executed: KPJ	Enclosure No. 1
Evaluated: KPJ	Approved: KPJ



Legend
- Isotropic compression
- Undrained compression

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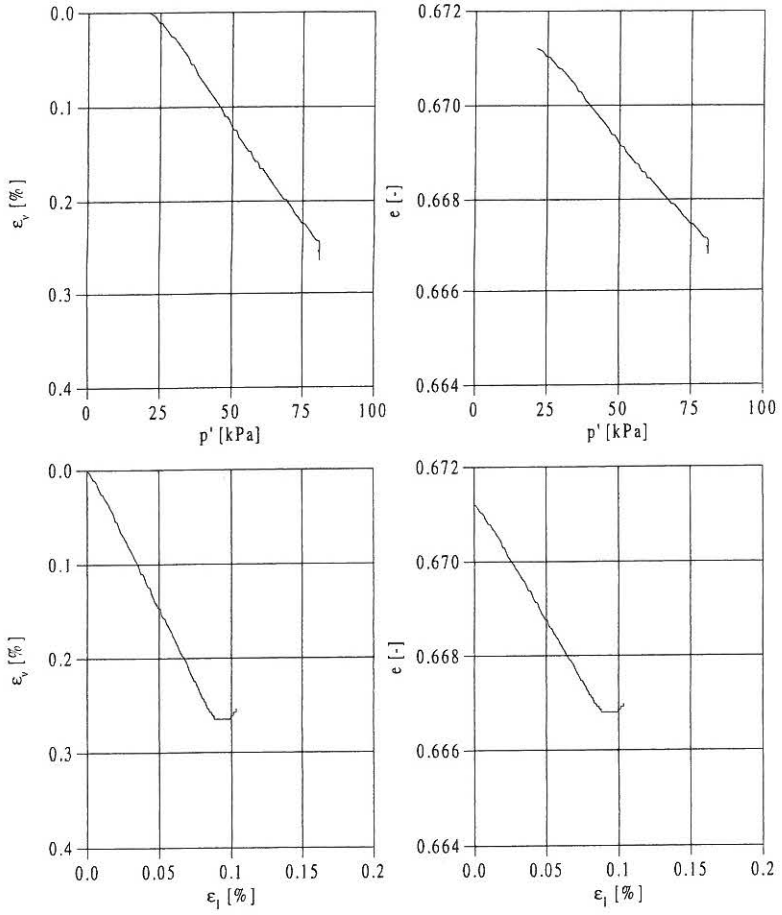
Executed: KPJ	Enclosure No. 1
Evaluated: KPJ	Approved: KPJ



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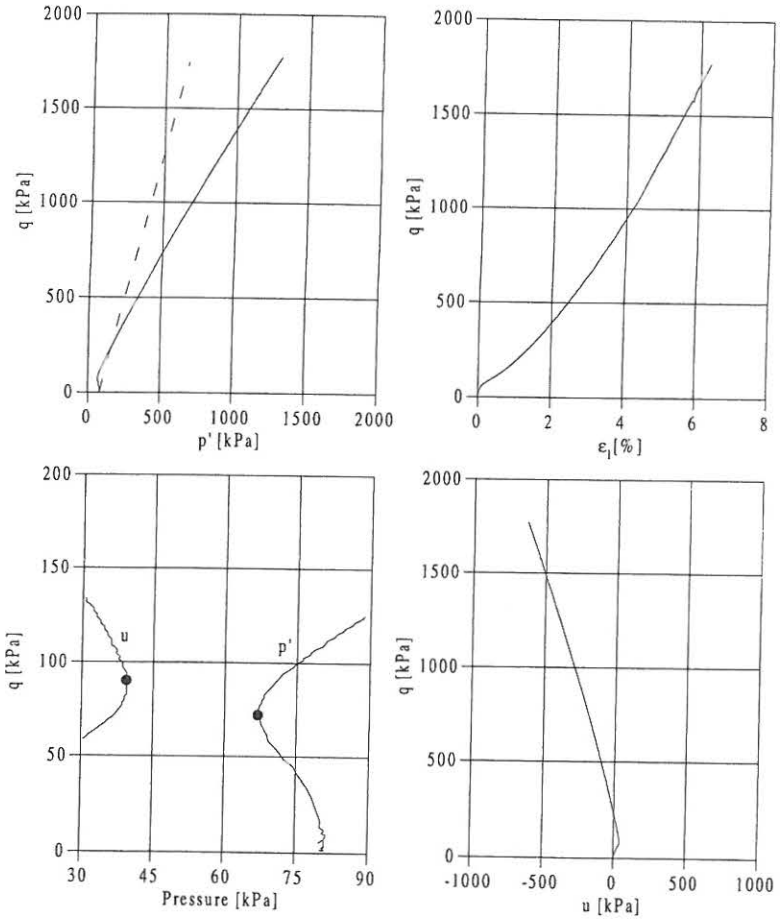

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Executed: KPJ	Enclosure No. 1
Evaluated: KPJ	Approved: KPJ

Description of soil Eastern Scheldt Sand	Triaxial Apparatus No. 2	Specimen properties
Specimen preparation Air pluviation	Calibration file Cal9710.dat	Height 71.47 mm Diameter 69.67 mm
Saturation procedure Water percolation	Date 1998-01-28	Void ratio 0.670

Test program	Isotropic compression, σ_3' :	20.0 - 640.0	kPa
	Loading rate:	5.0	kPa/min
	Undrained compression Deformation rate:	3.0	% ph.

Isotropic compression			
Confining pressure	σ_3'	640.0	kPa
Axial strain	ε_1	0.43	%
Volumetric strain	ε_v	1.26	%
Void ratio	e	0.649	

Undrained compression		Values at p'_{min}		Values at u_{max}	
Stress ratio	σ_1'/σ_3'	2.70		2.99	
Confining pressure	σ_3'	300.1	kPa	288.9	kPa
Pore pressure	u	339.9	kPa	351.1	kPa
Deviator stress	q	511.6	kPa	575.9	kPa
Mean normal stress	p'	470.6	kPa	480.9	kPa
Ratio	q / p'	1.09		1.20	
Axial strain	ε_1	1.10	%	1.33	%
Friction angle	φ'	27.4	°	30.0	°

Job: Ph.D. Project	Aalborg University
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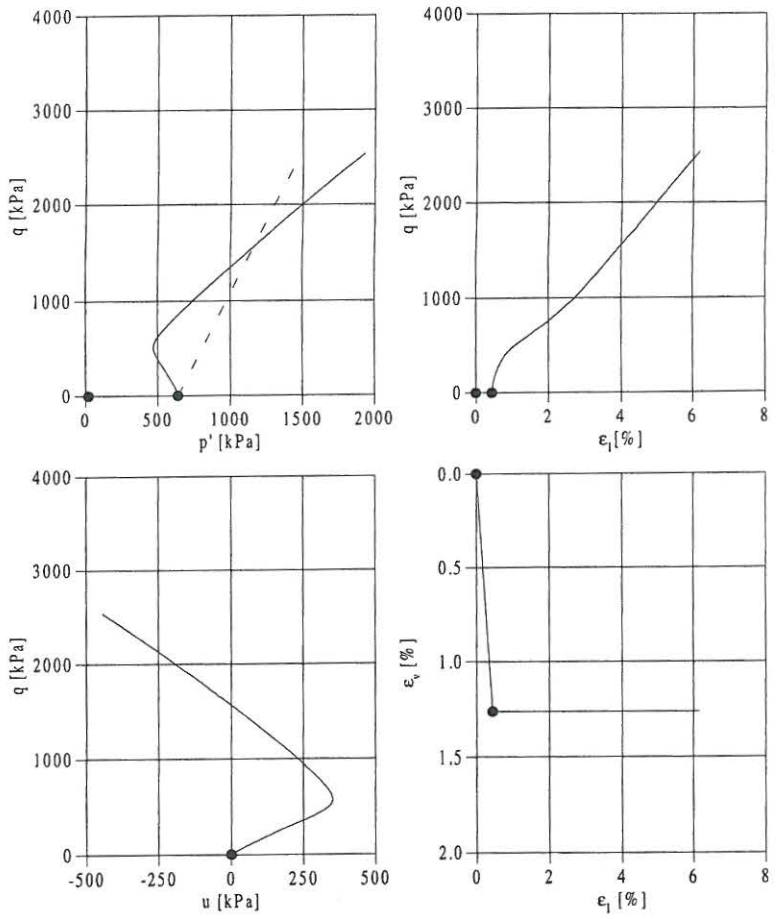

Legend
- Isotropic compression
- Undrained compression

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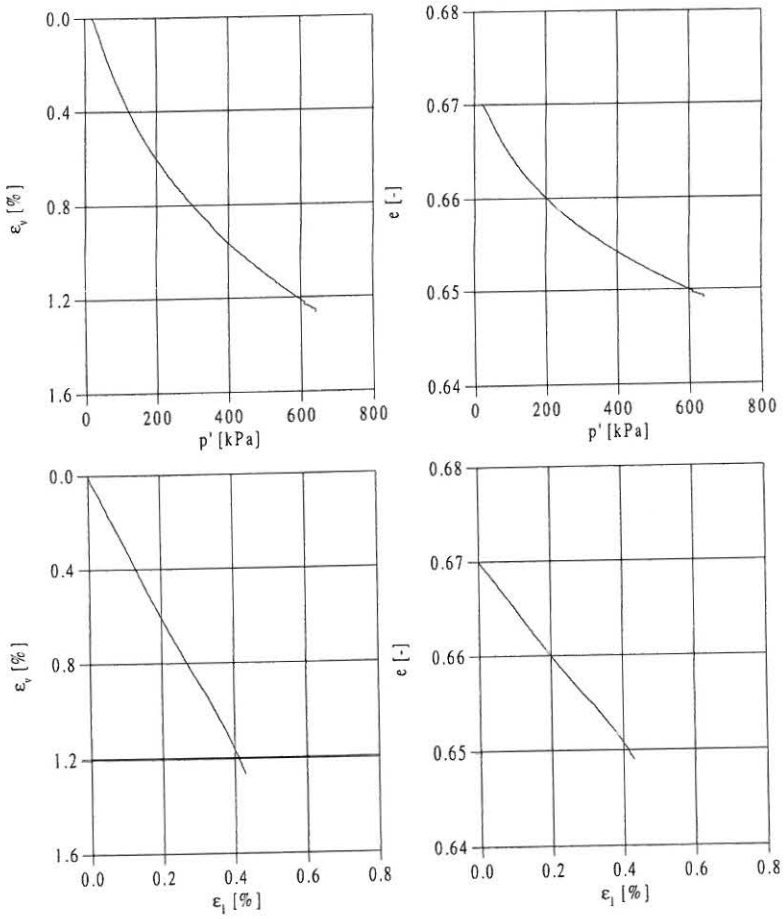
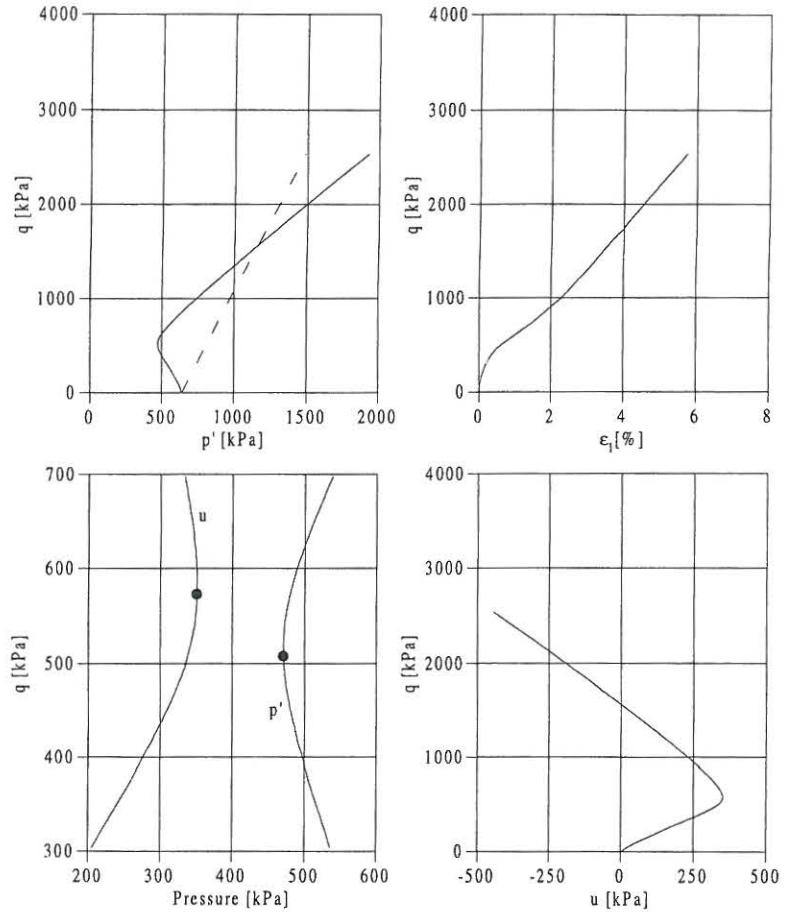
Evaluated: KPJ	Approved: KPJ



Remarks

Job: Ph.D. Project	Aalborg University
Executed: KPJ	Enclosure No. 2
Evaluated: KPJ	Approved: KPJ



Remarks

Job: Ph.D. Project	Aalborg University
Executed: KPJ	Enclosure No. 2
Evaluated: KPJ	Approved: KPJ

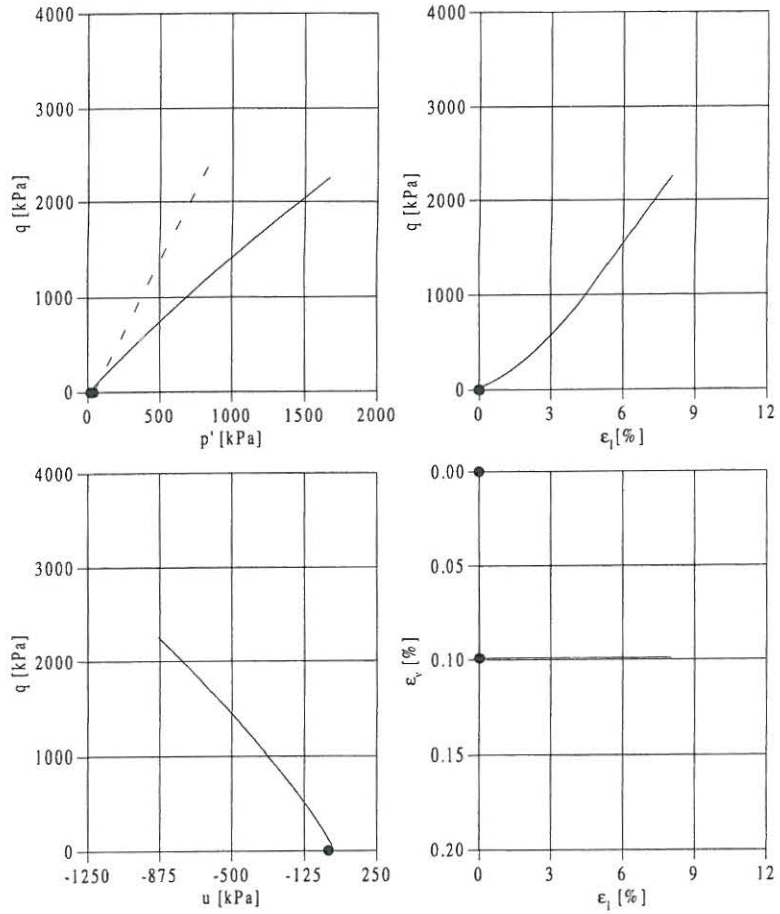
Description of soil	Triaxial Apparatus No. 2	Specimen properties	
Eastern Scheldt Sand			
Specimen preparation	Calibration file	Height	71.48 mm
Air pluviation	Cal97101.dat	Diameter	69.68 mm
Saturation procedure	Date	Void ratio	0.671
Water percolation	1998-02-01		

Test program			
	Isotropic compression, σ'_3 :	20.0 - 40.0	kPa
	Loading rate:	1.0	kPa/min
	Undrained compression		
	Deformation rate:	3.0	% ph.

Isotropic compression			
Confining pressure	σ'_3	40.0	kPa
Axial strain	ε_1	0.02	%
Volumetric strain	ε_v	0.10	%
Void ratio	e	0.669	

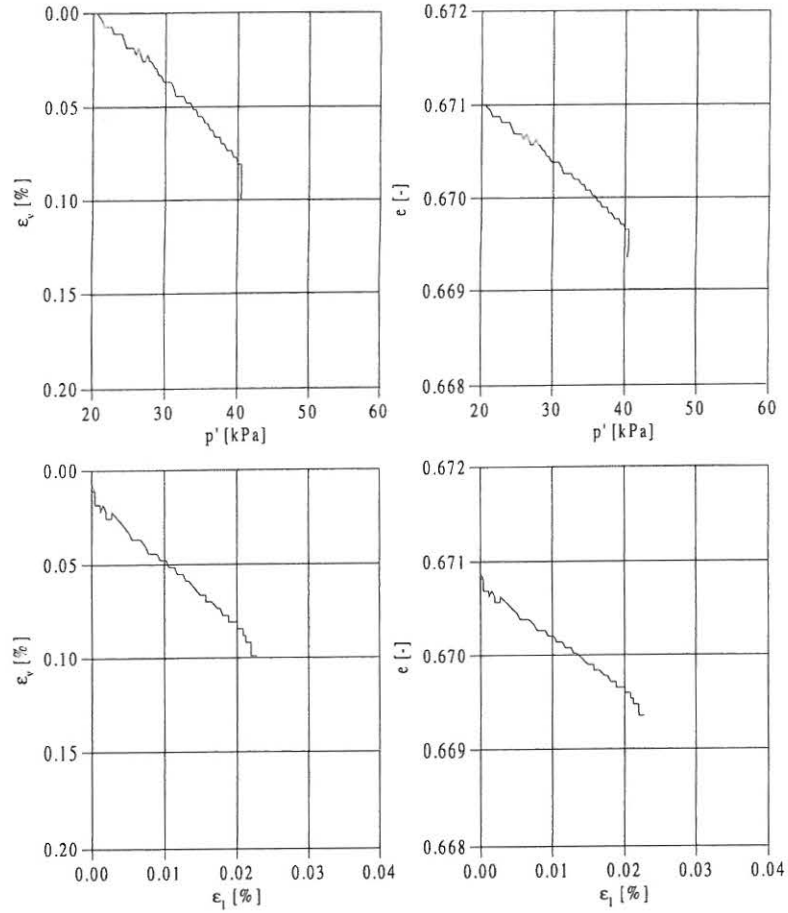
Undrained compression		Values at p'_{min}		Values at u_{max}	
Stress ratio	σ'_1/σ'_3	2.63		3.29	
Confining pressure	σ'_3	22.6	kPa	21.4	kPa
Pore pressure	u	17.5	kPa	18.6	kPa
Deviator stress	q	36.9	kPa	49.0	kPa
Mean normal stress	p'	34.8	kPa	37.8	kPa
Ratio	q / p'	1.06		1.30	
Axial strain	ε_1	0.13	%	0.25	%
Friction angle	φ'	26.7	°	32.2	°

Job: Ph.D. Project	Aalborg University
Executed: KPJ	Enclosure No. 3
Evaluated: KPJ	Approved: KPJ



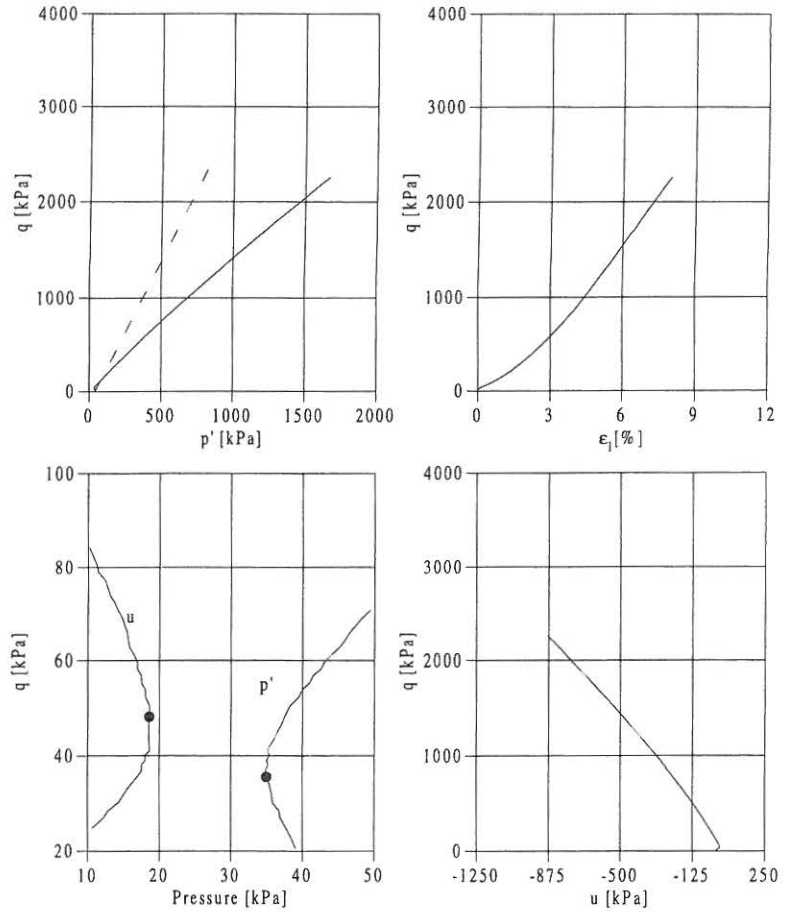
Legend
- Isotropic compression
- Undrained compression

Job: Ph.D. Project	Aalborg University
Executed: KPJ	Enclosure No. 3
Evaluated: KPJ	Approved: KPJ



Remarks

Job: Ph.D. Project	Aalborg University
Executed: KPJ	Enclosure No. 3
Evaluated: KPJ	Approved: KPJ



Remarks

Job: Ph.D. Project	Aalborg University
Executed: KPJ	Enclosure No. 3
Evaluated: KPJ	Approved: KPJ

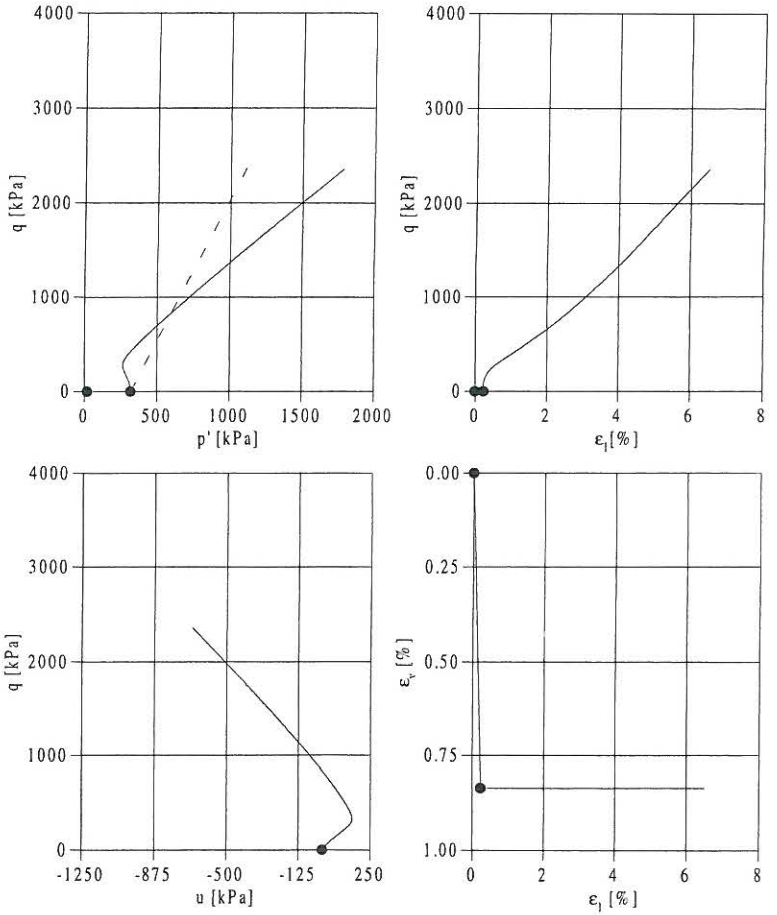
Description of soil	Triaxial Apparatus No. 2	Specimen properties	
Eastern Scheldt Sand			
Specimen preparation	Calibration file	Height	71.51 mm
Air pluviation	Cal9710.dat	Diameter	69.71 mm
Saturation procedure	Date	Void ratio	0.673
Water percolation	1998-01-15		

Test program			
	Isotropic compression, σ'_3 :	20.0 - 320.0	kPa
	Loading rate:	5.0	kPa/min
	Undrained compression Deformation rate:	3.0	% ph.

Isotropic compression			
Confining pressure	σ'_3	319.9	kPa
Axial strain	ε_1	0.24	%
Volumetric strain	ε_v	0.84	%
Void ratio	e	0.659	

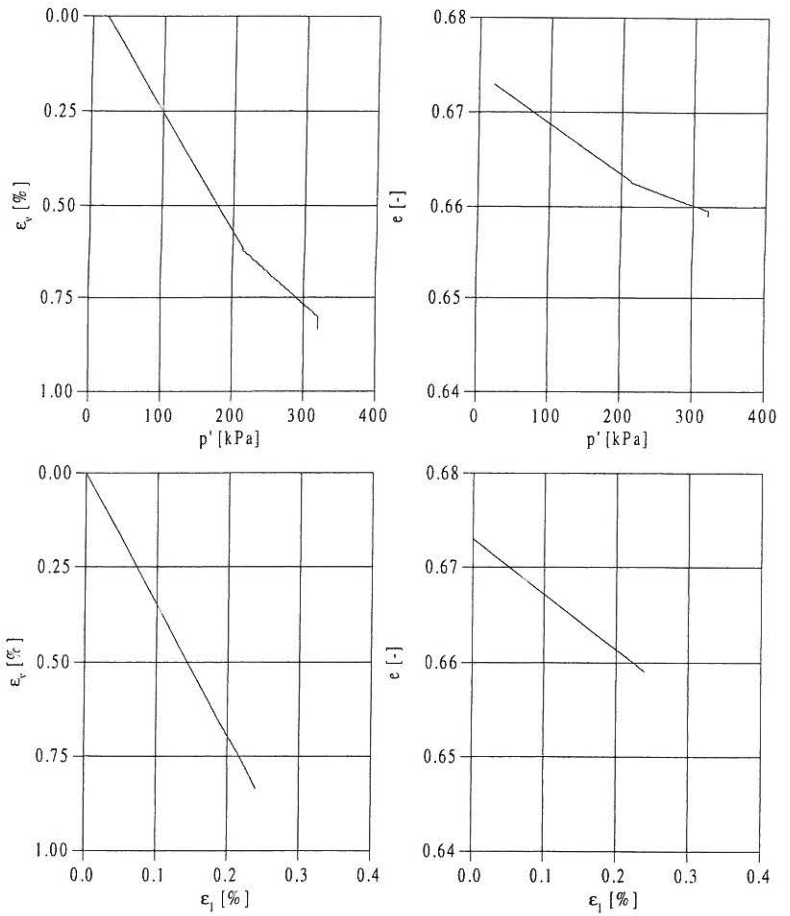
Undrained compression		Values at p'_{min}		Values at u_{max}	
Stress ratio	σ'_1/σ'_3	2.57		2.98	
Confining pressure	σ'_3	173.3	kPa	163.8	kPa
Pore pressure	u	146.6	kPa	156.1	kPa
Deviator stress	q	271.8	kPa	324.9	kPa
Mean normal stress	p'	263.9	kPa	272.2	kPa
Ratio	q / p'	1.03		1.19	
Axial strain	ε_1	0.53	%	0.74	%
Friction angle	φ'	26.1	°	29.9	°

Job: Ph.D. Project	Aalborg University
Executed: KPJ	Enclosure No. 4
Evaluated: KPJ	Approved: KPJ



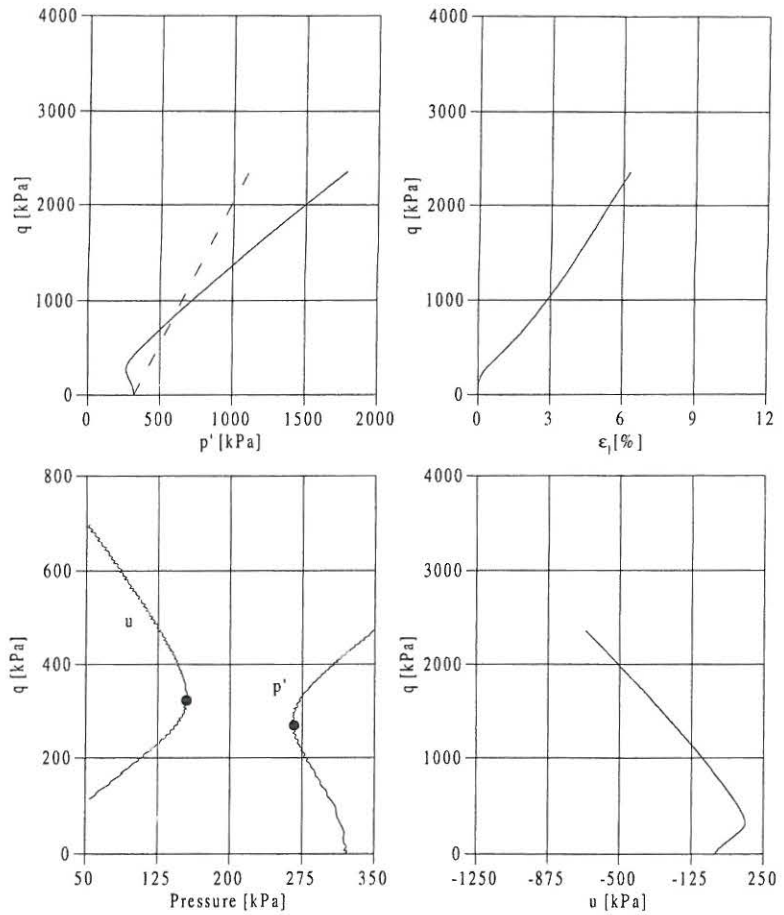
Legend			
●	Isotropic compression		
——	Undrained compression		

Job: Ph.D. Project	Aalborg University
Executed: KPJ	Enclosure No. 4
Evaluated: KPJ	Approved: KPJ



Remarks

Job: Ph.D. Project	Aalborg University
Executed: KPJ	Enclosure No. 4
Evaluated: KPJ	Approved: KPJ



Remarks

Job: Ph.D. Project	Aalborg University
Executed: KPJ	Enclosure No. 4
Evaluated: KPJ	Approved: KPJ

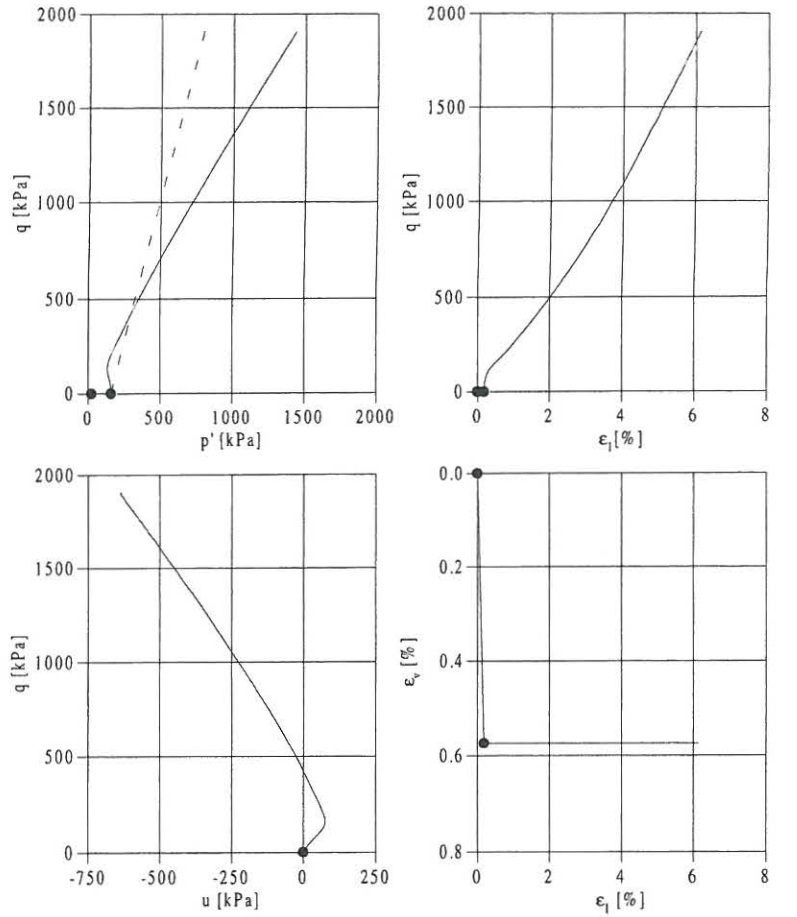
Description of soil	Triaxial Apparatus No. 2	Specimen properties	
Eastern Scheldt Sand			
Specimen preparation	Calibration file	Height	71.48 mm
Air pluviation	Cal9710.dat	Diameter	69.68 mm
Saturation procedure	Date	Void ratio	0.671
Water percolation	1998-01-17		

Test program			
	Isotropic compression, σ'_3 :	20.0 - 160.0	kPa
	Loading rate:	5.0	kPa/min
	Undrained compression		
	Deformation rate:	3.0	% ph.

Isotropic compression			
Confining pressure	σ'_3	160.0	kPa
Axial strain	ε_1	0.18	%
Volumetric strain	ε_v	0.57	%
Void ratio	e	0.661	

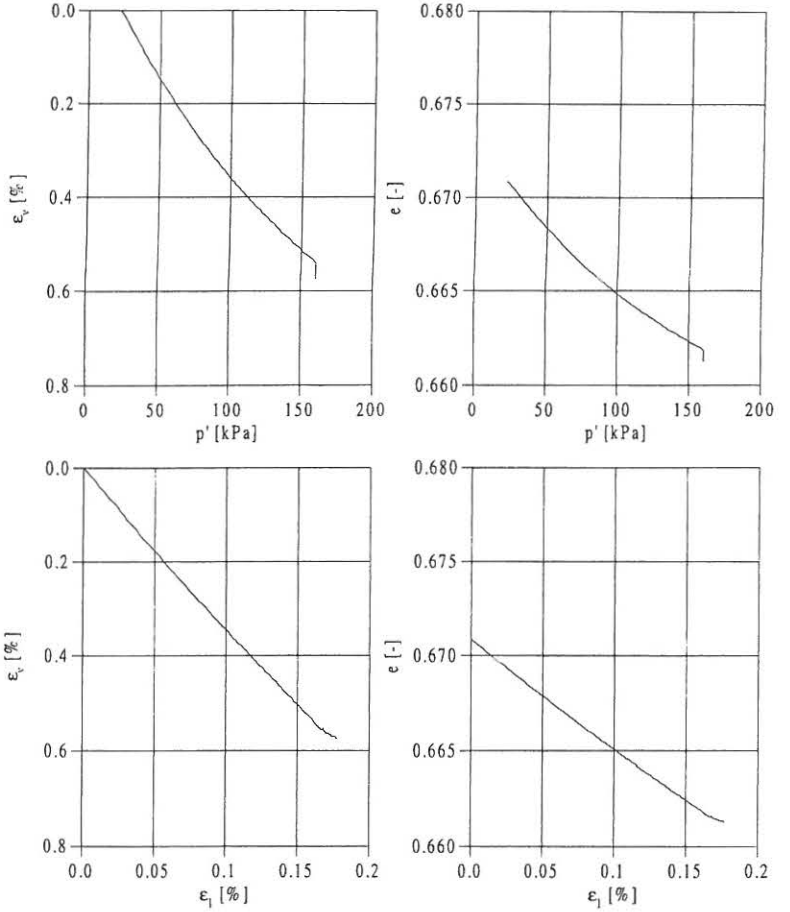
Undrained compression		Values at p'_{min}		Values at u_{max}	
Stress ratio	σ'_1/σ'_3	2.53		2.90	
Confining pressure	σ'_3	88.5	kPa	84.8	kPa
Pore pressure	u	71.7	kPa	75.3	kPa
Deviator stress	q	135.6	kPa	160.8	kPa
Mean normal stress	p'	133.7	kPa	138.4	kPa
Ratio	q / p'	1.01		1.16	
Axial strain	ε_1	0.41	%	0.54	%
Friction angle	φ'	25.7	°	29.1	°

Job: Ph.D. Project	Aalborg University
Executed: KPJ	Enclosure No. 5
Evaluated: KPJ	Approved: KPJ



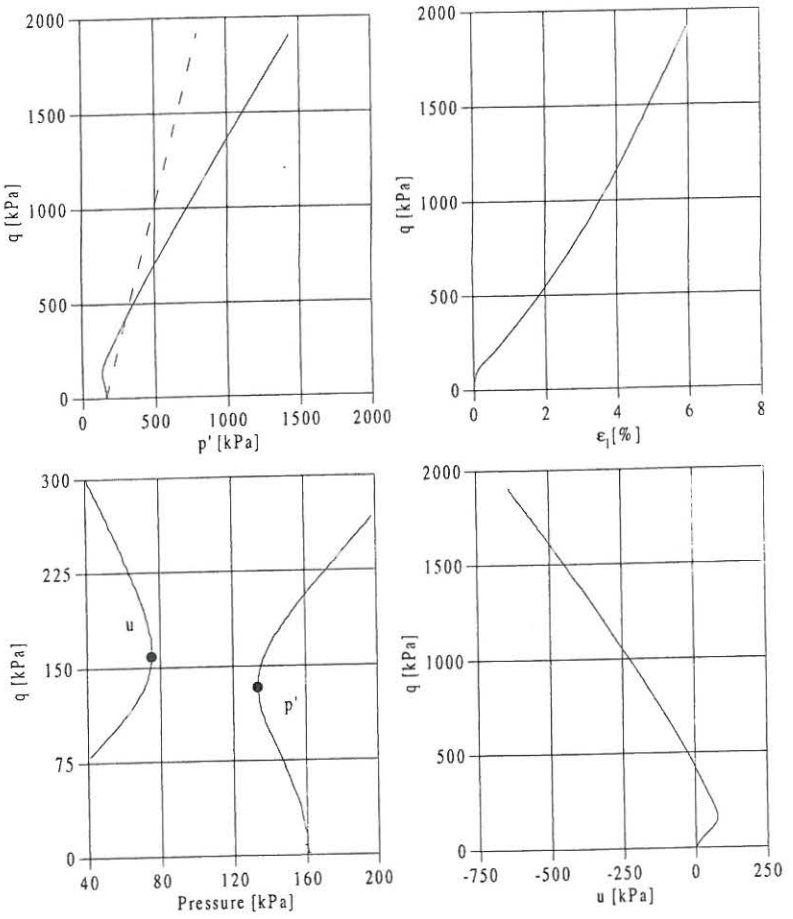
Legend
- Isotropic compression
- Undrained compression

Job: Ph.D. Project	Aalborg University
Executed: KPJ	Enclosure No. 5
Evaluated: KPJ	Approved: KPJ



Remarks

Job: Ph.D. Project	Aalborg University
Executed: KPJ	Enclosure No. 5
Evaluated: KPJ	Approved: KPJ



Remarks

Job: Ph.D. Project	Aalborg University
Executed: KPJ	Enclosure No. 5
Evaluated: KPJ	Approved: KPJ

Description of soil	Triaxial Apparatus No. 2	Specimen properties	
Eastern Scheldt Sand			
Specimen preparation	Calibration file	Height	71.49 mm
Air pluviation	Cal97103.dat	Diameter	69.69 mm
Saturation procedure	Date	Void ratio	0.671
CO_2 / Backpressure	1998-05-04	B-value	0.980

Test program			
	Isotropic compression, σ'_3 :	20.0 - 271.8	kPa
	Loading rate:	5.0	kPa/min
	Undrained compression $\Delta p' = 0$ (TSP)		
	Deformation rate:	3.0	% ph.
	Minimum pore pressure, u_{min} :	0.0	kPa
	Drained compression $\Delta p' = 0$ (ESP)		
	Deformation rate:	3.0	% ph.

Isotropic compression			
Confining pressure	σ'_3	271.7	kPa
Axial strain	ε_1	0.23	%
Volumetric strain	ε_v	0.36	%
Void ratio	e	0.666	

Undrained compression		Values at p_{min}		Values at u_{max}	
Stress ratio	σ'_1/σ'_3	2.42		2.42	
Confining pressure	σ'_3	147.2	kPa	147.2	kPa
Pore pressure	u	55.1	kPa	55.1	kPa
Deviator stress	q	208.5	kPa	208.5	kPa
Mean normal stress	p'	216.7	kPa	216.7	kPa
Ratio	q / p'	0.96		0.96	
Axial strain	ε_1	0.67	%	0.67	%
Friction angle	φ'	24.5	°	24.5	°

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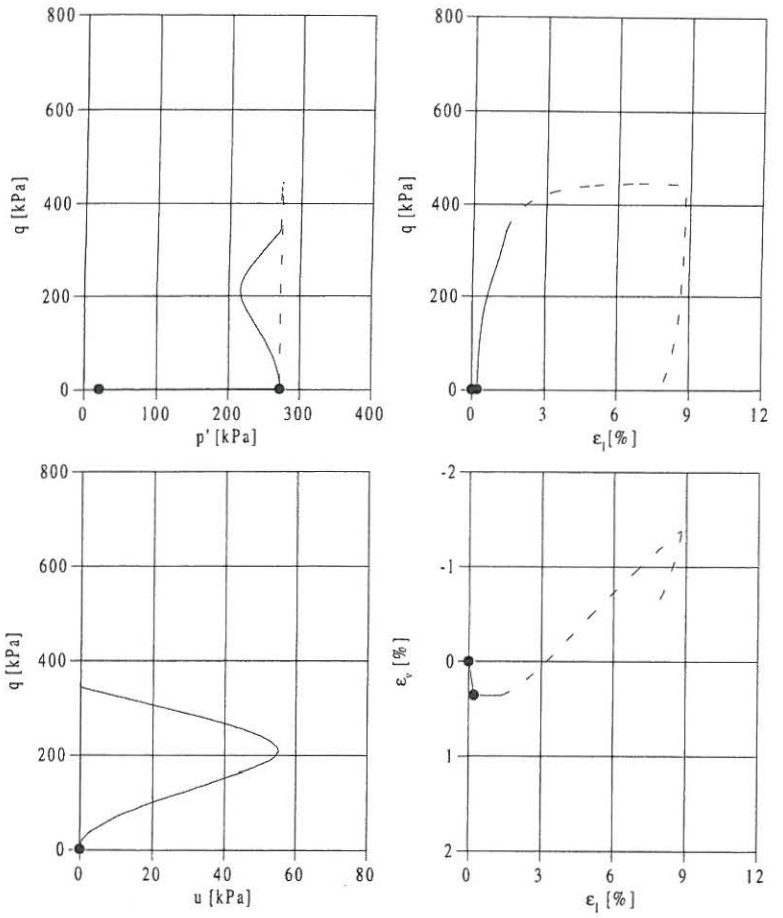
Executed: KPJ	Enclosure No. 6
Evaluated: KPJ	Approved: KPJ

Drained compression		Values at failure	
Stress ratio	σ_1'/σ_3'	4.56	
Confining pressure	σ_3'	124.9	kPa
Deviator stress	q	445.3	kPa
Mean normal stress	p'	273.4	kPa
Ratio	q / p'	1.63	
Axial strain	ε_1	6.33	%
Volumetric strain	ε_v	-0.81	%
Void ratio	e	0.685	
Friction angle	φ'	39.8	°
Angle of dilation	ψ	6.4	°

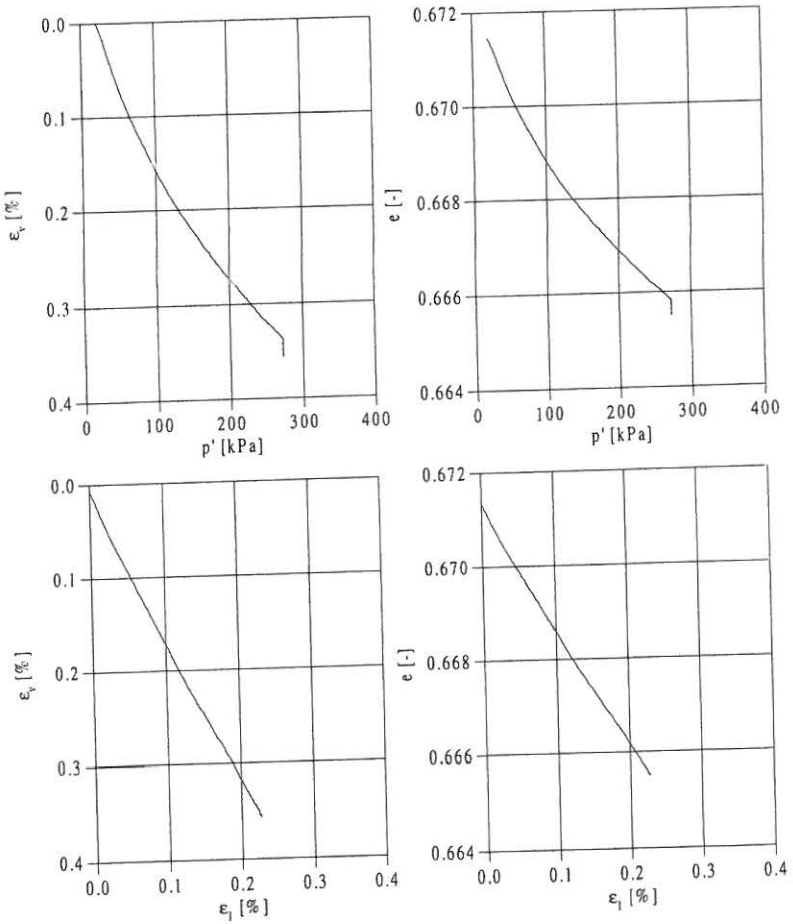
Elastic properties			
Shear modulus	G	76.7	MPa
Deviator stress	q	372.5	kPa
Mean normal stress	p'	273.6	kPa

Job: Ph.D. Project	Aalborg University
Executed: KPJ	Enclosure No. 6
Evaluated: KPJ	Approved: KPJ



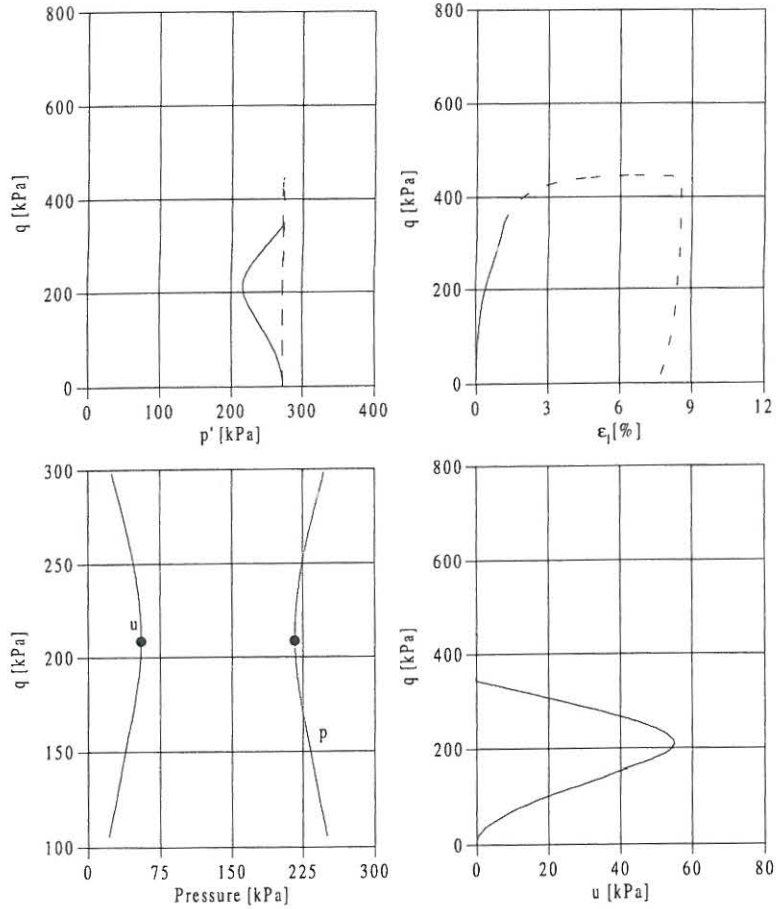
Job: Ph.D. Project	Aalborg University
Executed: KPJ	Enclosure No. 6
Evaluated: KPJ	Approved: KPJ

Legend
- Isotropic compression
- Undrained compression
- Drained compression



Job: Ph.D. Project	Aalborg University
Executed: KPJ	Enclosure No. 6
Evaluated: KPJ	Approved: KPJ

Remarks



Job: Ph.D. Project	Aalborg University
Executed: KPJ	Enclosure No. 6
Evaluated: KPJ	Approved: KPJ

Remarks

CU Triaxial Test No. 9710.27

Description of soil	Triaxial Apparatus No. 2	Specimen properties	
Eastern Scheldt Sand			
Specimen preparation	Calibration file	Height	71.45 mm
Air pluviation	Cal97103.dat	Diameter	69.65 mm
Saturation procedure	Date	Void ratio	0.669
CO_2 / Backpressure	1998-05-06	B-value	0.987

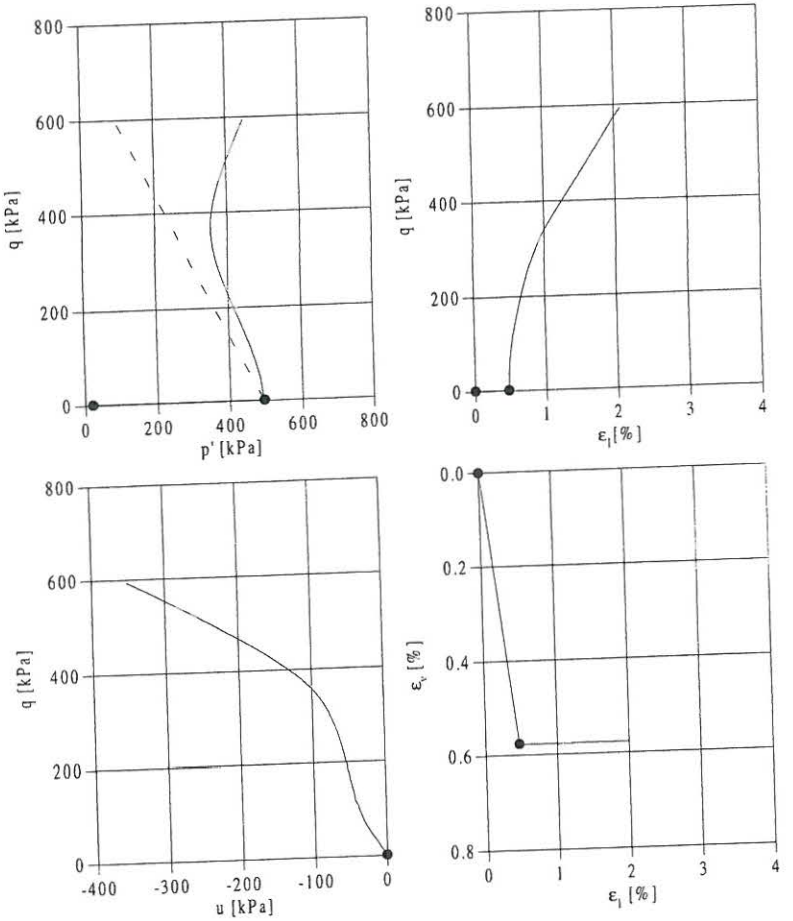
Test program			
	Isotropic compression, σ'_3 :	20.0 - 494.2	kPa
	Loading rate:	5.0	kPa/min
	Undrained compression $\Delta q / \Delta p' = -1.5$ (TSP)		
	Deformation rate:	3.0	% ph.

Isotropic compression			
Confining pressure	σ'_3	494.2	kPa
Axial strain	ε_1	0.47	%
Volumetric strain	ε_v	0.58	%
Void ratio	e	0.659	

Undrained compression		Values at p_{min}	
Stress ratio	σ'_1/σ'_3	2.58	
Confining pressure	σ'_3	231.7	kPa
Pore pressure	u	-105.7	kPa
Deviator stress	q	366.6	kPa
Mean normal stress	p'	353.9	kPa
Ratio	q / p'	1.04	
Axial strain	ε_1	1.11	%
Friction angle	φ'	26.2	°

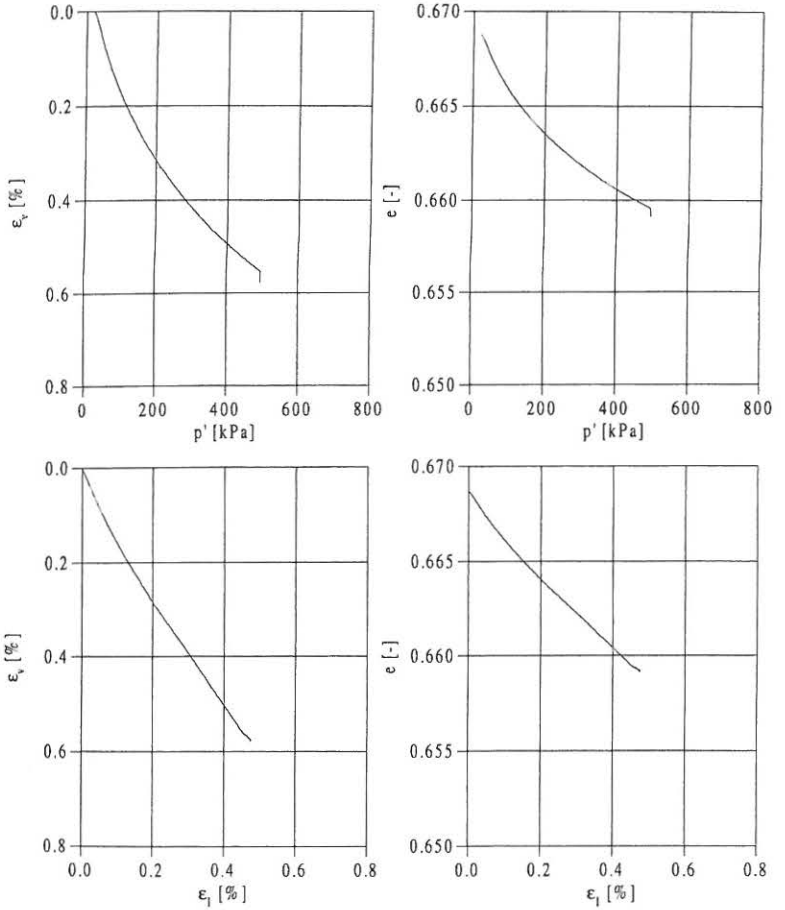
Remarks: B-value obtained at a backpressure of 200 kPa. Backpressure increased to 400 kPa before start of isotropic compression.

Job: Ph.D. Project	Aalborg University
Executed: KPJ	Enclosure No. 7
Evaluated: KPJ	Approved: KPJ



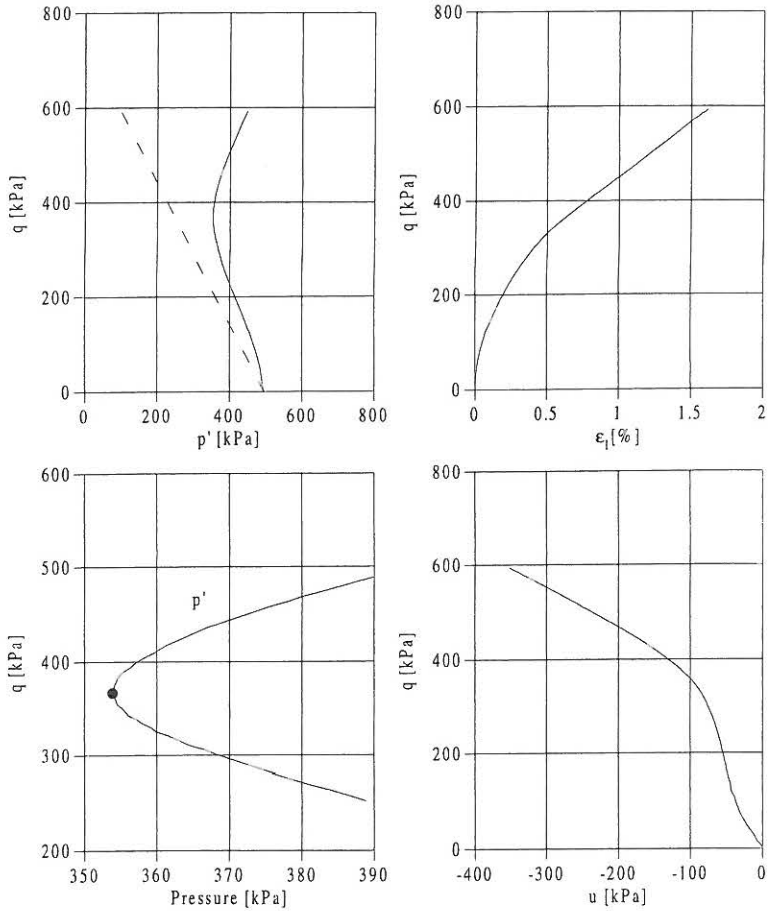
Legend
- Isotropic compression
- Undrained compression

Job: Ph.D. Project	Aalborg University
Executed: KPJ	Enclosure No. 7
Evaluated: KPJ	Approved: KPJ



Remarks

Job: Ph.D. Project	Aalborg University
Executed: KPJ	Enclosure No. 7
Evaluated: KPJ	Approved: KPJ



Remarks

Job: Ph.D. Project	Aalborg University
Executed: KPJ	Enclosure No. 7
Evaluated: KPJ	Approved: KPJ

Description of soil	Triaxial Apparatus No. 2	Specimen properties	
Eastern Scheldt Sand			
Specimen preparation	Calibration file	Height	71.48 mm
Air pluviation	Cal97103.dat	Diameter	69.68 mm
Saturation procedure	Date	Void ratio	0.670
CO_2 / Backpressure	1998-05-08	B-value	0.987

Test program			
	Isotropic compression, σ'_3 :	20.0 - 104.3	kPa
	Loading rate:	4.0	kPa/min
	Undrained compression $\Delta q / \Delta p' = 2$ (TSP)		
	Deformation rate:	3.0	% ph.
	Minimum pore pressure, u_{min} :	0.0	kPa
	Drained compression $\Delta q / \Delta p' = 2$ (ESP)		
	Deformation rate:	3.0	% ph.

Isotropic compression			
Confining pressure	σ'_3	104.4	kPa
Axial strain	ε_1	0.13	%
Volumetric strain	ε_v	0.18	%
Void ratio	e	0.667	

Undrained compression		Values at p_{min}		Values at u_{max}	
Stress ratio	σ'_1/σ'_3	2.75		3.47	
Confining pressure	σ'_3	53.5	kPa	52.9	kPa
Pore pressure	u	66.3	kPa	72.9	kPa
Deviator stress	q	93.6	kPa	130.1	kPa
Mean normal stress	p'	84.7	kPa	96.3	kPa
Ratio	q / p'	1.10		1.35	
Axial strain	ε_1	0.37	%	0.67	%
Friction angle	φ'	27.8	°	33.5	°

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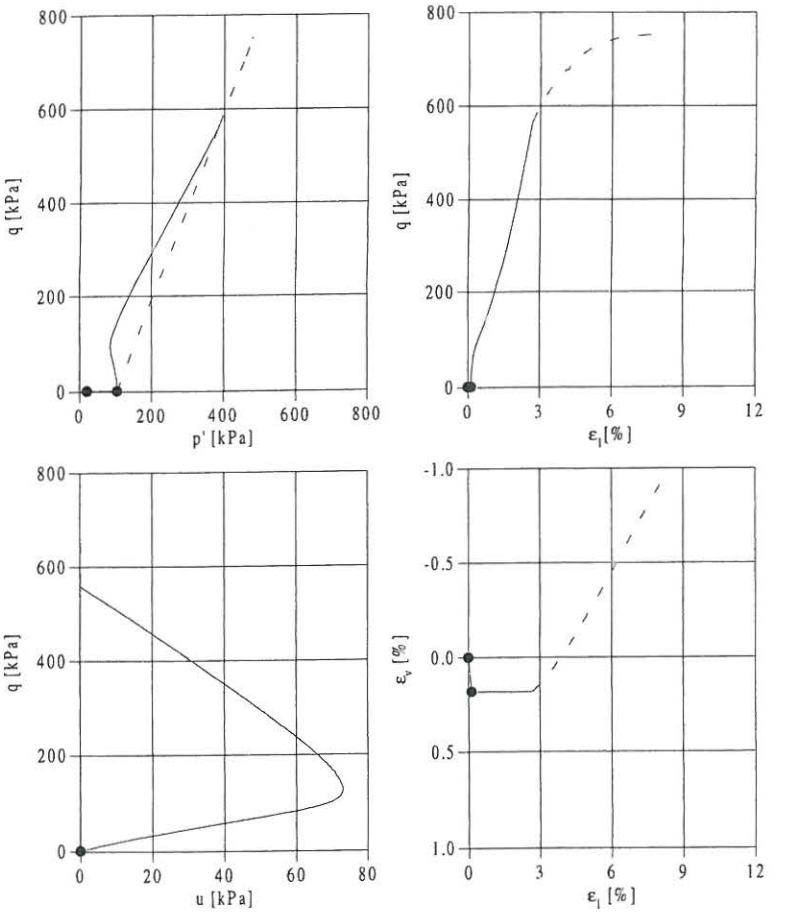
Executed: KPJ	Enclosure No. 8
Evaluated: KPJ	Approved: KPJ

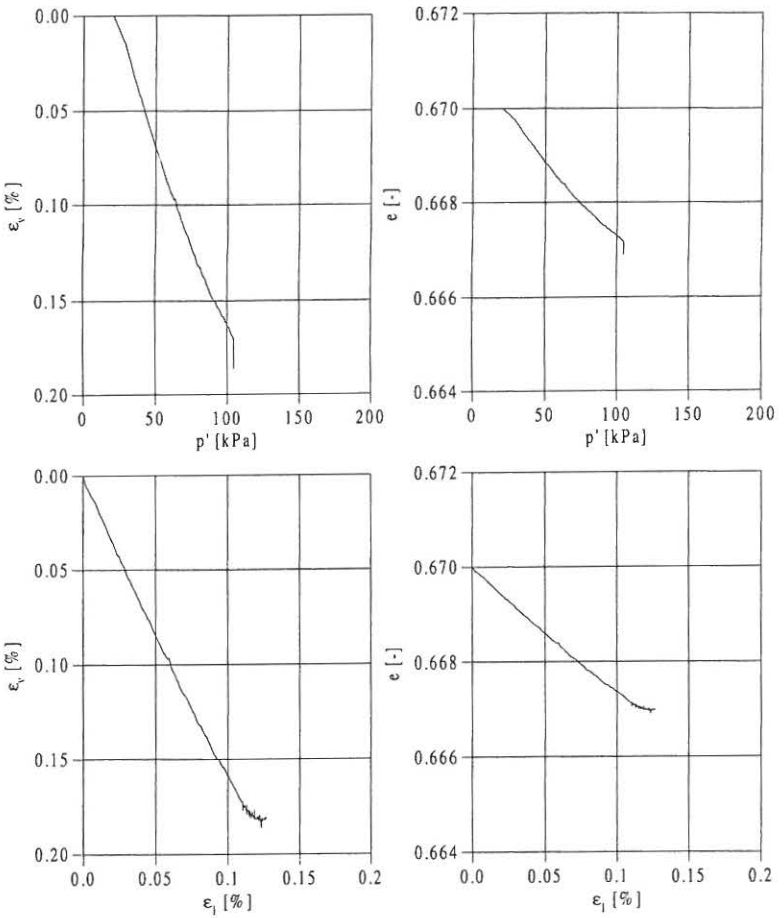
Drained compression		Values at failure	
Stress ratio	σ_1'/σ_3'	4.29	
Confining pressure	σ_3'	228.3	kPa
Deviator stress	q	750.3	kPa
Mean normal stress	p'	478.4	kPa
Ratio	q / p'	1.57	
Axial strain	ε_1	7.04	%
Volumetric strain	ε_v	-0.69	%
Void ratio	e	0.682	
Friction angle	φ'	38.4	°
Angle of dilation	ψ	6.0	°

Job: Ph.D. Project	Aalborg University
Executed: KPJ	Enclosure No. 8
Evaluated: KPJ	Approved: KPJ



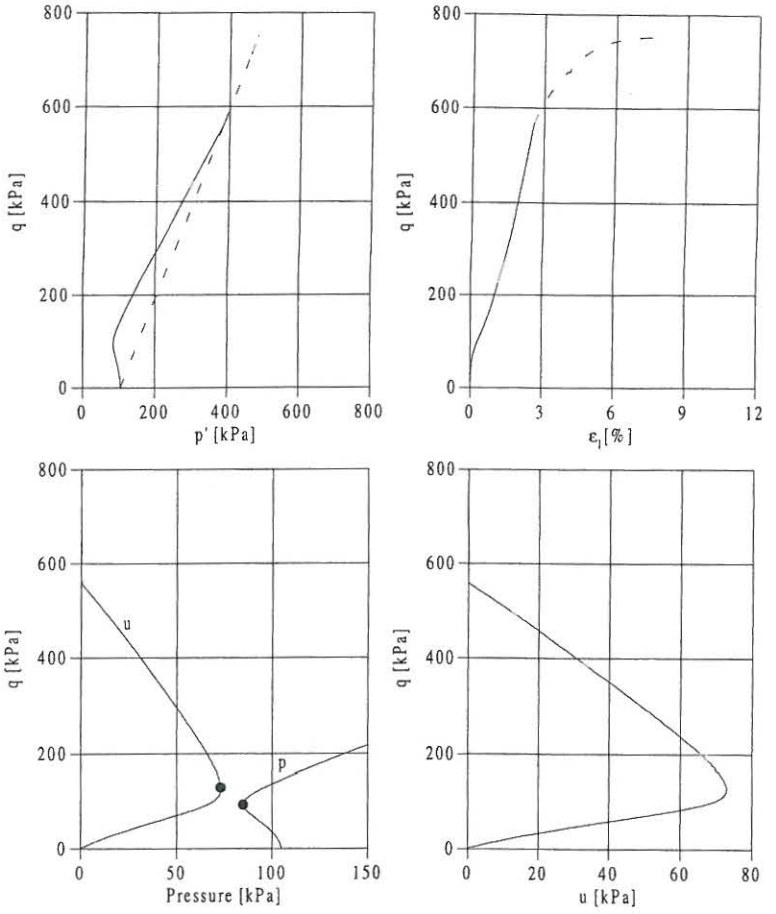
Job: Ph.D. Project	Aalborg University
Executed: KPJ	Enclosure No. 8
Evaluated: KPJ	Approved: KPJ

Legend
- ● Isotropic compression
- —— Undrained compression
- – – – Drained compression



Job: Ph.D. Project	Aalborg University
Executed: KPJ	Enclosure No. 8
Evaluated: KPJ	Approved: KPJ

Remarks



Job: Ph.D. Project	Aalborg University
Executed: KPJ	Enclosure No. 8
Evaluated: KPJ	Approved: KPJ

Remarks

CU Triaxial Test No. 9710.29

Description of soil	Triaxial Apparatus No. 2	Specimen properties	
Eastern Scheldt Sand			
Specimen preparation	Calibration file	Height	71.48 mm
Air pluviation	Cal97103.dat	Diameter	69.68 mm
Saturation procedure	Date	Void ratio	0.633
CO_2 / Backpressure	1998-05-05	B-value	0.976

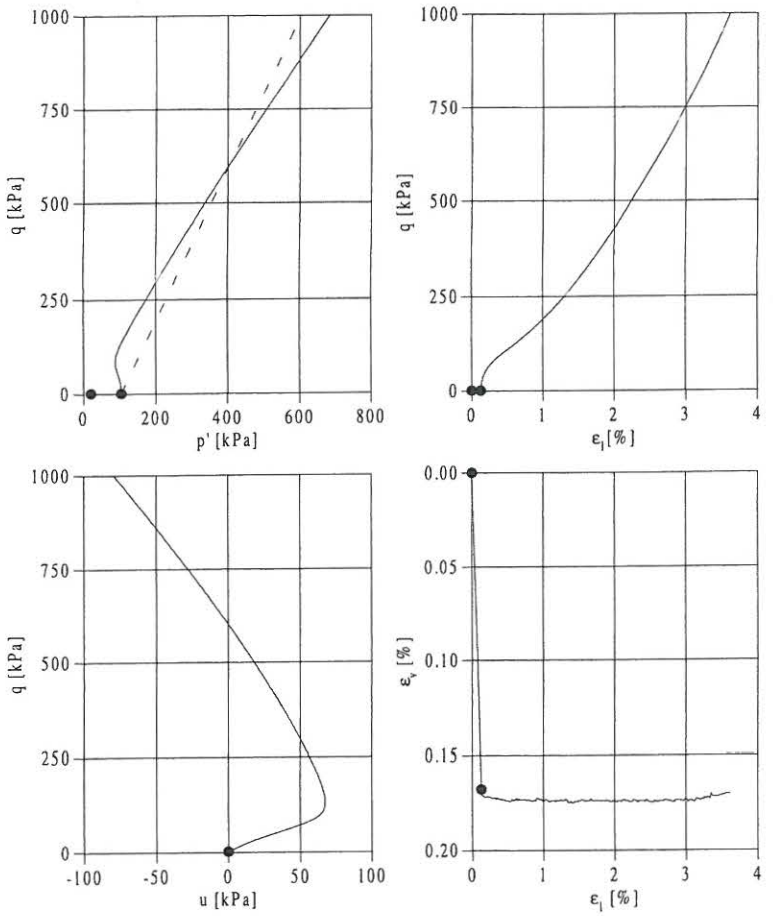
Test program			
	Isotropic compression, σ'_3 :	20.0 - 104.3	kPa
	Loading rate:	5.0	kPa/min
	Undrained compression $\Delta q / \Delta p' = 2$ (TSP)		
	Deformation rate:	3.0	% ph.

Isotropic compression			
Confining pressure	σ'_3	104.2	kPa
Axial strain	ε_1	0.13	%
Volumetric strain	ε_v	0.17	%
Void ratio	e	0.630	

Undrained compression		Values at p_{min}		Values at u_{max}	
Stress ratio	σ'_1/σ'_3	2.50		3.26	
Confining pressure	σ'_3	58.6	kPa	59.1	kPa
Pore pressure	u	60.2	kPa	67.2	kPa
Deviator stress	q	87.7	kPa	133.7	kPa
Mean normal stress	p'	87.8	kPa	103.7	kPa
Ratio	q / p'	1.00		1.29	
Axial strain	ε_1	0.35	%	0.67	%
Friction angle	φ'	25.4	°	32.0	°

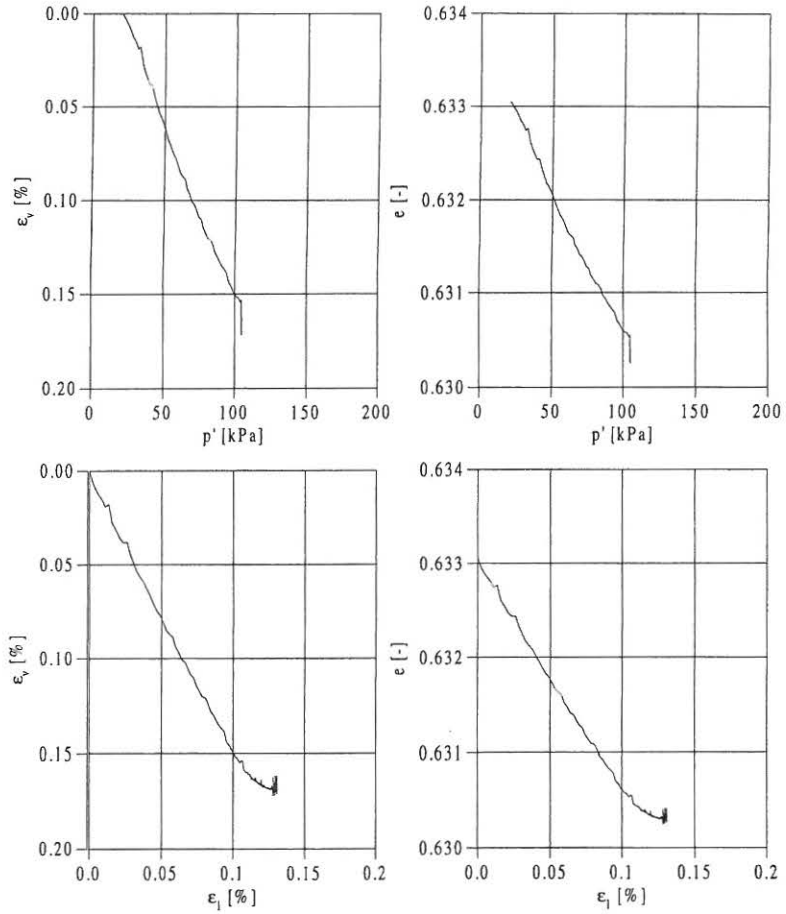
Remarks: B-value obtained at a backpressure of 200 kPa. Backpressure increased to 400 kPa before start of isotropic compression.

Job: Ph.D. Project	Aalborg University
Executed: KPJ	Enclosure No. 9
Evaluated: KPJ	Approved: KPJ



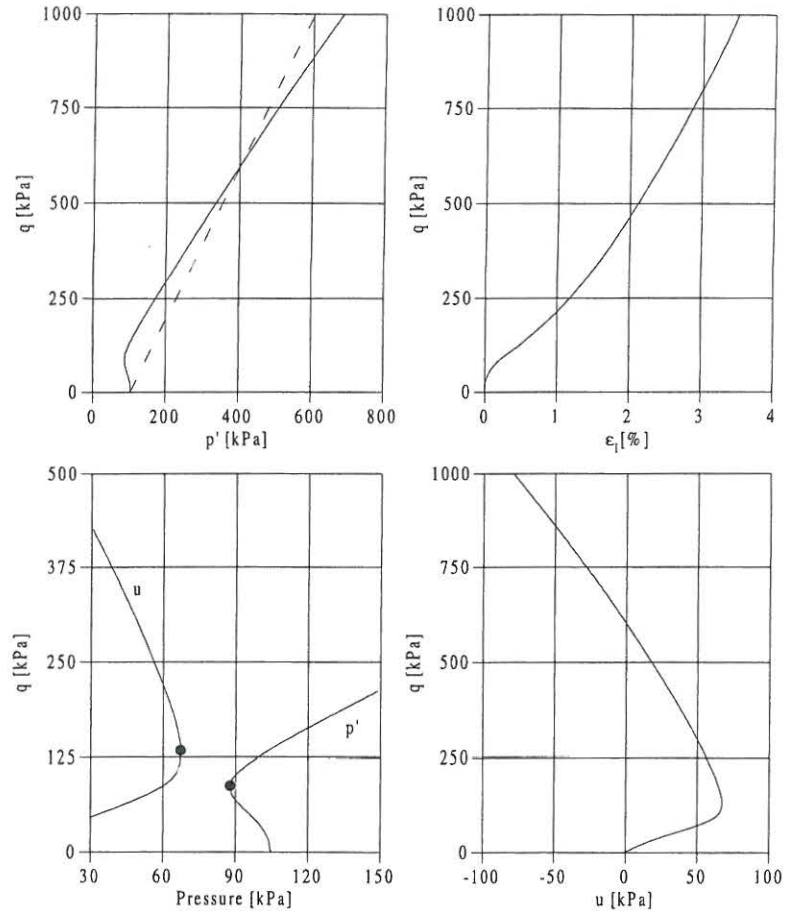
Legend
- Isotropic compression
- Undrained compression

Job: Ph.D. Project	Aalborg University
Executed: KPJ	Enclosure No. 9
Evaluated: KPJ	Approved: KPJ



Remarks

Job: Ph.D. Project	Aalborg University
Executed: KPJ	Enclosure No. 9
Evaluated: KPJ	Approved: KPJ



Remarks

Job: Ph.D. Project	Aalborg University
Executed: KPJ	Enclosure No. 9
Evaluated: KPJ	Approved: KPJ

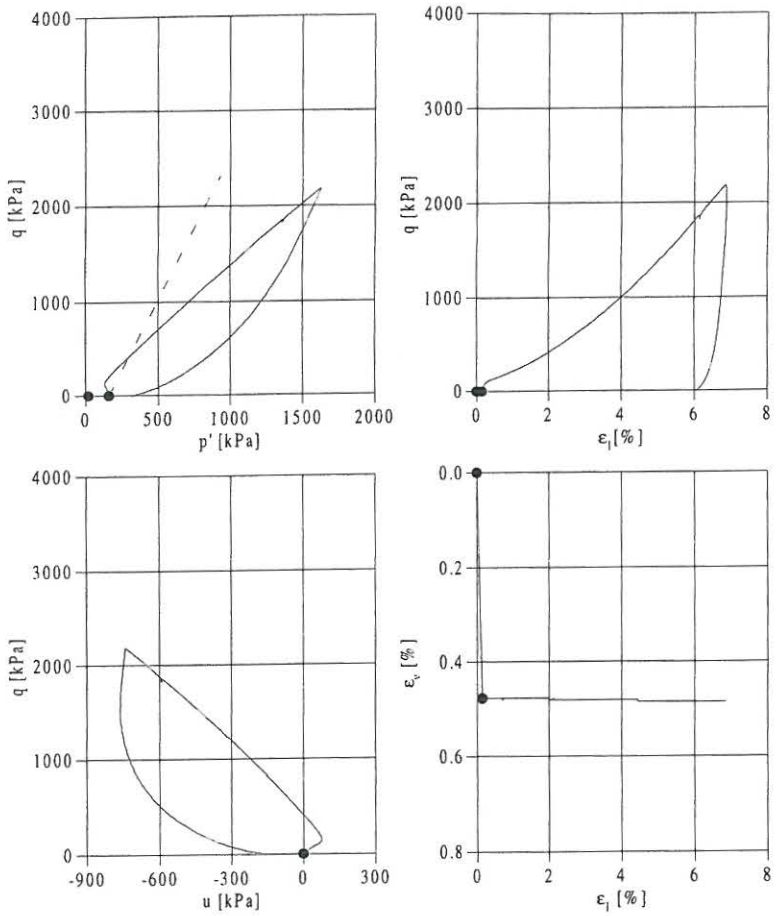
Description of soil	Triaxial Apparatus No. 2	Specimen properties	
Eastern Scheldt Sand			
Specimen preparation	Calibration file	Height	71.50 mm
Air pluviation	Cal97105.dat	Diameter	69.70 mm
Saturation procedure	Date	Void ratio	0.672
Water percolation	1998-05-09		

Test program			
	Isotropic compression, σ'_3 :	20.0 - 160.0	kPa
	Loading rate:	3.0	kPa/min
	Undrained compression Deformation rate:	3.0	% ph.

Isotropic compression			
Confining pressure	σ'_3	160.0	kPa
Axial strain	ε_1	0.15	%
Volumetric strain	ε_v	0.48	%
Void ratio	e	0.664	

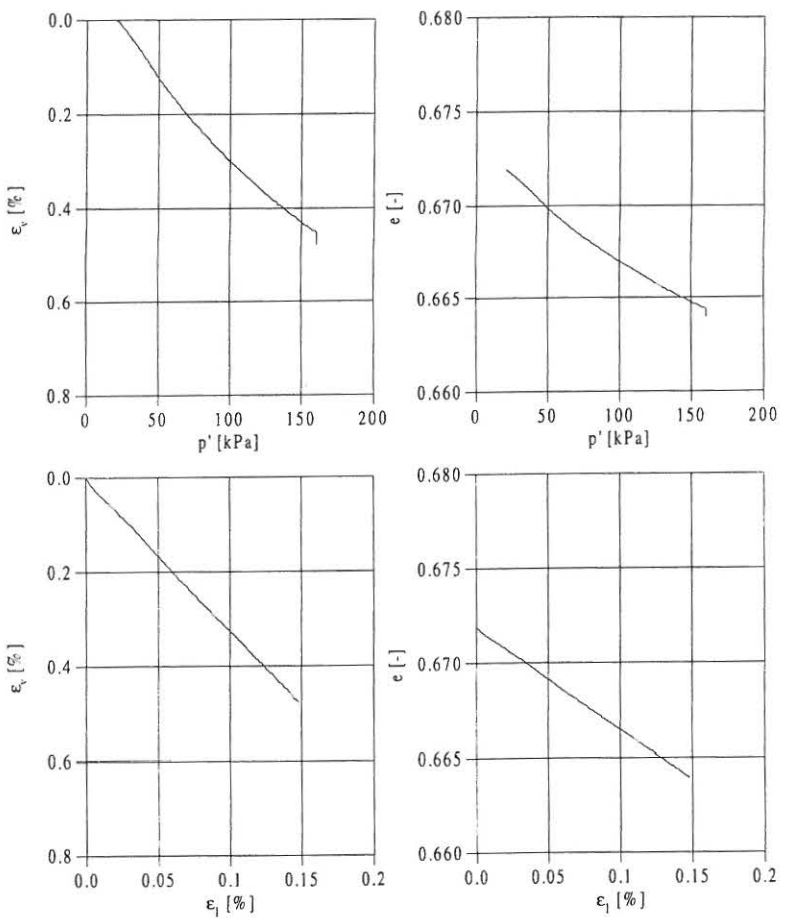
Undrained compression		Values at p'_{min}		Values at u_{max}	
Stress ratio	σ'_1/σ'_3	2.49		2.76	
Confining pressure	σ'_3	86.9	kPa	84.5	kPa
Pore pressure	u	73.2	kPa	75.6	kPa
Deviator stress	q	129.3	kPa	148.6	kPa
Mean normal stress	p'	130.0	kPa	134.0	kPa
Ratio	q / p'	0.99		1.11	
Axial strain	ε_1	0.44	%	0.59	%
Friction angle	φ'	25.2	°	27.9	°

Job: Ph.D. Project	Aalborg University
Executed: KPJ	Enclosure No. 10
Evaluated: KPJ	Approved: KPJ



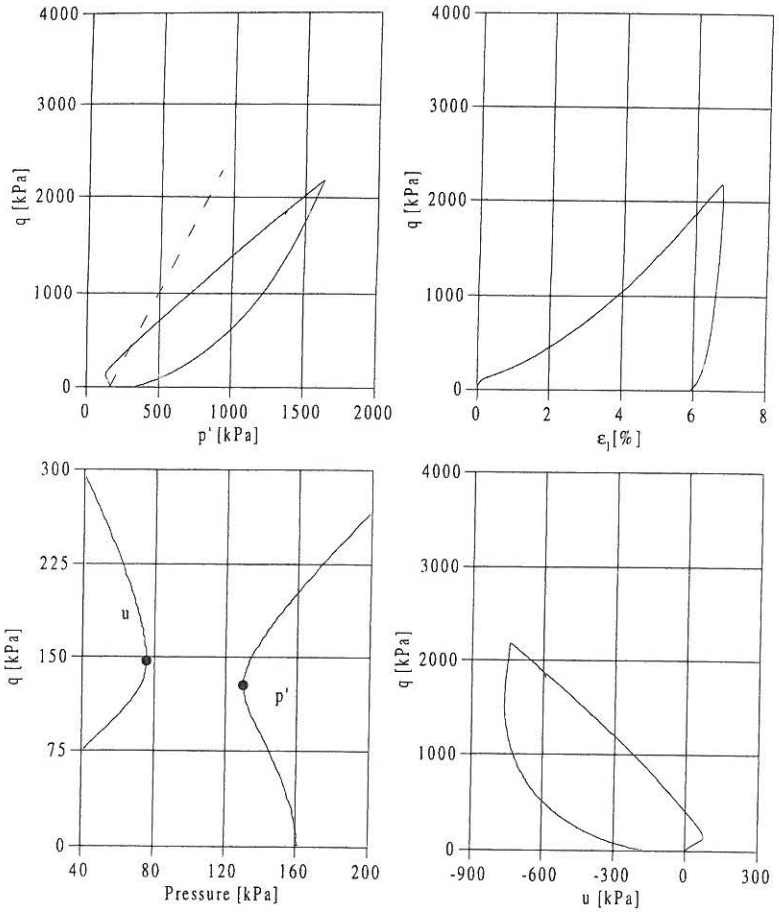
Legend
- Isotropic compression
- Undrained compression

Job: Ph.D. Project	Aalborg University
Executed: KPJ	Enclosure No. 10
Evaluated: KPJ	Approved: KPJ



Remarks

Job: Ph.D. Project	Aalborg University
Executed: KPJ	Enclosure No. 10
Evaluated: KPJ	Approved: KPJ



Remarks

Job: Ph.D. Project	Aalborg University
Executed: KPJ	Enclosure No. 10
Evaluated: KPJ	Approved: KPJ

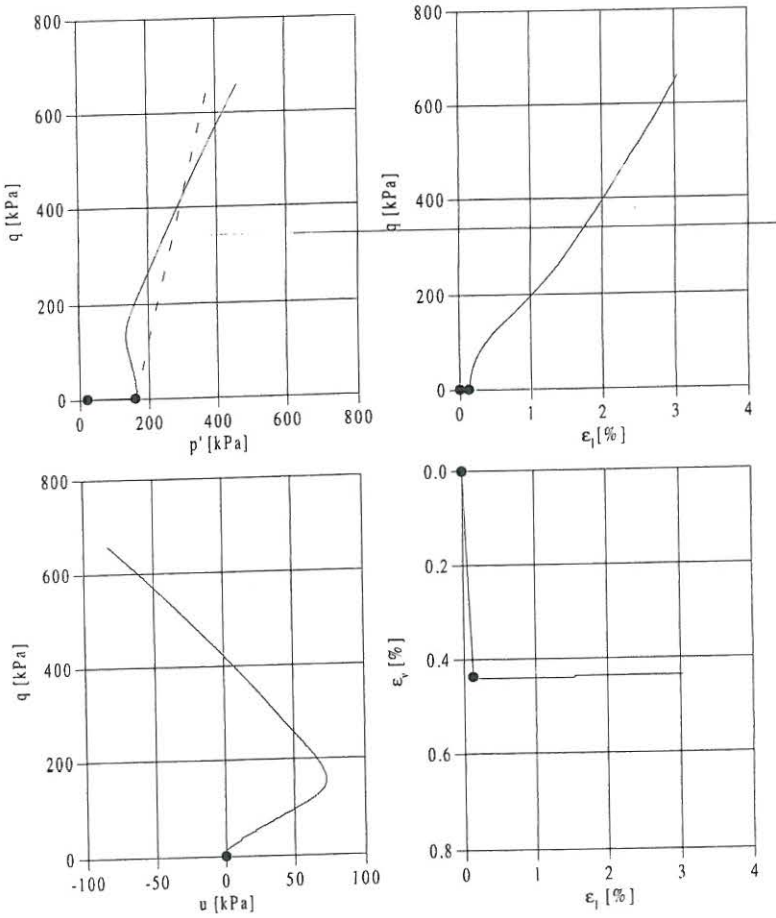
Description of soil	Triaxial Apparatus No. 2	Specimen properties	
Eastern Scheldt Sand			
Specimen preparation	Calibration file	Height	71.52 mm
Air pluviation	Cal97105.dat	Diameter	69.72 mm
Saturation procedure	Date	Void ratio	0.673
Water percolation	1998-06-10		

Test program			
	Isotropic compression, σ'_3 :	20.0 - 160.0	kPa
	Loading rate:	5.0	kPa/min
	Undrained compression		
	Deformation rate:	3.0	% ph.

Isotropic compression			
Confining pressure	σ'_3	160.0	kPa
Axial strain	ε_1	0.13	%
Volumetric strain	ε_v	0.44	%
Void ratio	e	0.666	

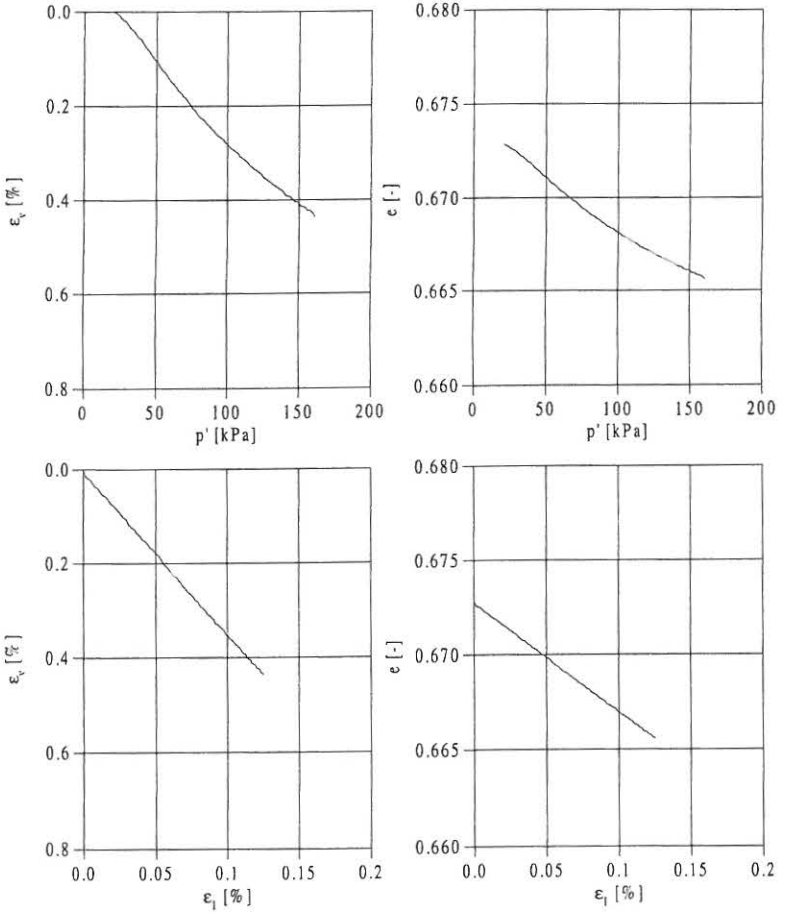
Undrained compression		Values at p'_{min}		Values at u_{max}	
Stress ratio	σ'_1/σ'_3	2.50		2.85	
Confining pressure	σ'_3	89.8	kPa	86.3	kPa
Pore pressure	u	69.3	kPa	72.8	kPa
Deviator stress	q	135.1	kPa	159.5	kPa
Mean normal stress	p'	134.9	kPa	139.5	kPa
Ratio	q / p'	1.00		1.14	
Axial strain	ε_1	0.58	%	0.75	%
Friction angle	φ'	25.4	°	28.7	°

Job: Ph.D. Project	Aalborg University
Executed: UP, KPJ	Enclosure No. 11
Evaluated: KPJ	Approved: KPJ



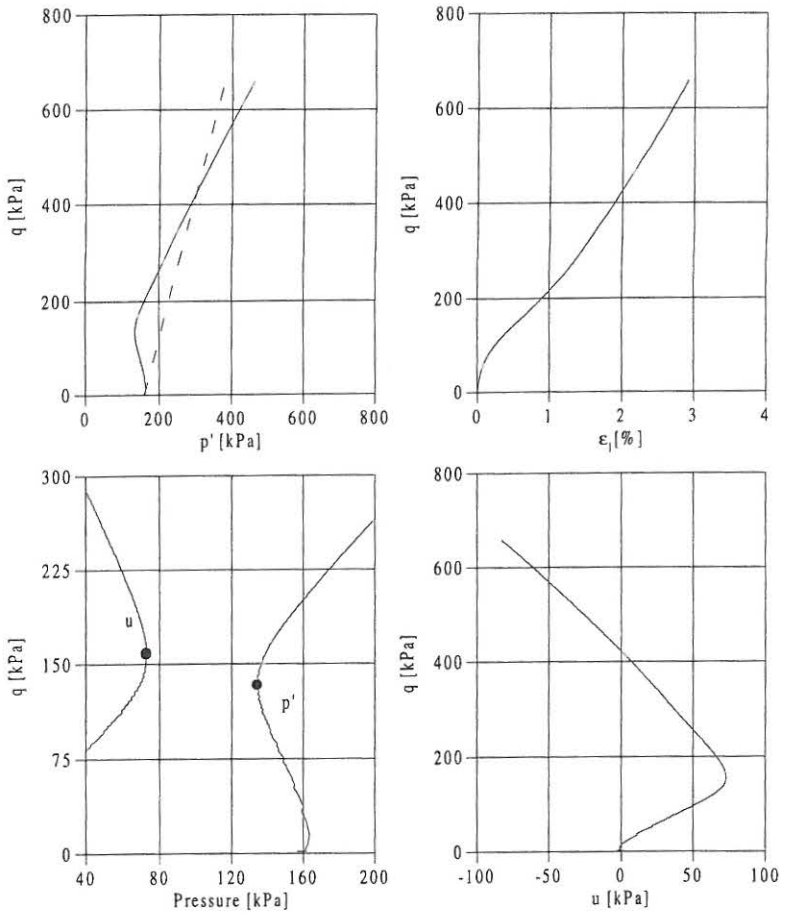
Legend
- Isotropic compression
- Undrained compression

Job: Ph.D. Project	Aalborg University
Executed: UP, KPJ	Enclosure No. 11
Evaluated: KPJ	Approved: KPJ



Remarks

Job: Ph.D. Project	Aalborg University
Executed: UP, KPJ	Enclosure No. 11
Evaluated: KPJ	Approved: KPJ



Remarks

Job: Ph.D. Project	Aalborg University
Executed: UP, KPJ	Enclosure No. 11
Evaluated: KPJ	Approved: KPJ

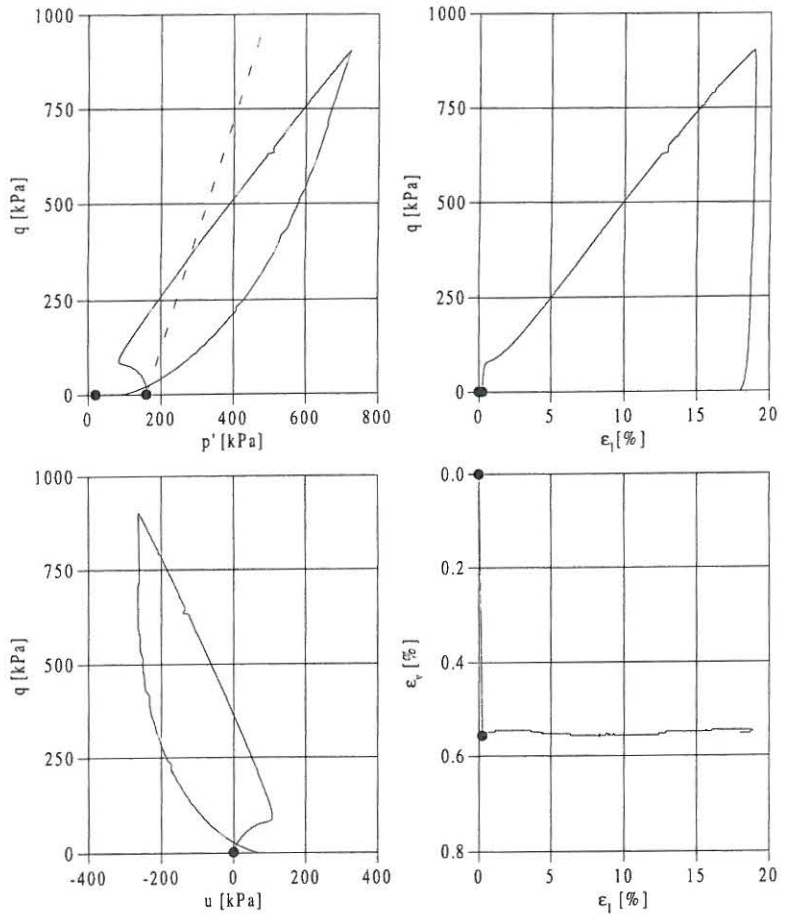
Description of soil	Triaxial Apparatus No. 2	Specimen properties	
Eastern Scheldt Sand			
Specimen preparation	Calibration file	Height	71.46 mm
Pluviation	Cal97106.dat	Diameter	69.66 mm
Saturation procedure	Date	Void ratio	0.825
Water percolation	1998-09-04		

Test program			
	Isotropic compression, σ_3' :	20.0 - 160.0	kPa
	Loading rate:	5.0	kPa/min
	Undrained compression Deformation rate:	3.0	% ph.

Isotropic compression			
Confining pressure	σ_3'	160.1	kPa
Axial strain	ε_1	0.24	%
Volumetric strain	ε_v	0.56	%
Void ratio	e	0.815	

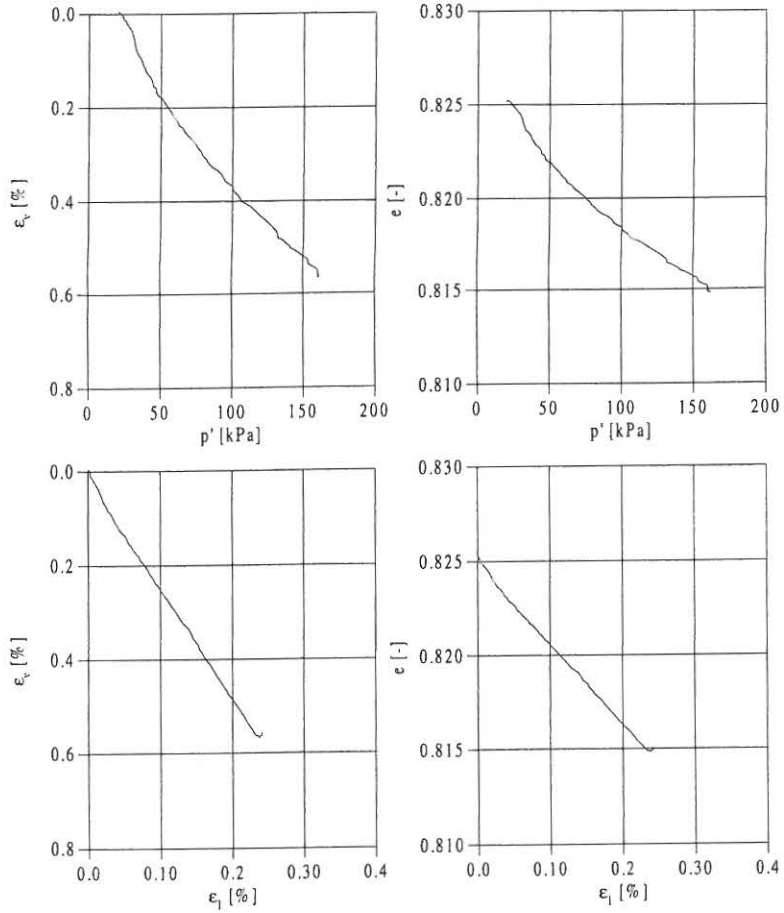
Undrained compression		Values at p'_{min}		Values at u_{max}	
Stress ratio	σ_1'/σ_3'	2.65		2.81	
Confining pressure	σ_3'	54.0	kPa	53.4	kPa
Pore pressure	u	106.0	kPa	106.6	kPa
Deviator stress	q	88.8	kPa	96.4	kPa
Mean normal stress	p'	83.6	kPa	85.5	kPa
Ratio	q / p'	1.06		1.13	
Axial strain	ε_1	1.13	%	1.41	%
Friction angle	φ'	26.8	°	28.3	°

Job: Ph.D. Project	Aalborg University
Executed: KPJ	Enclosure No. 12
Evaluated: KPJ	Approved: KPJ



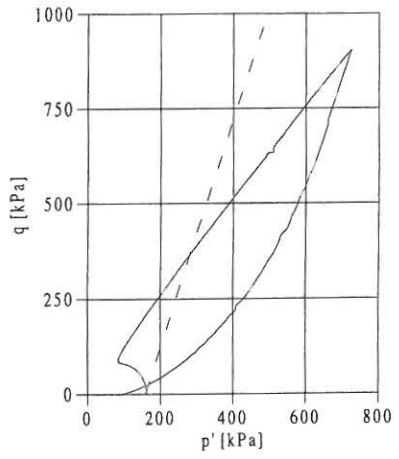
Legend
- Isotropic compression
- Undrained compression

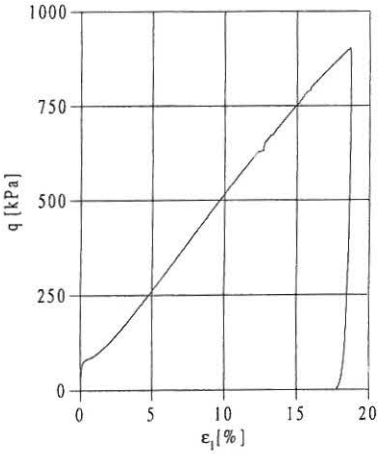
Job: Ph.D. Project	Aalborg University
Executed: KPJ	Enclosure No. 12
Evaluated: KPJ	Approved: KPJ

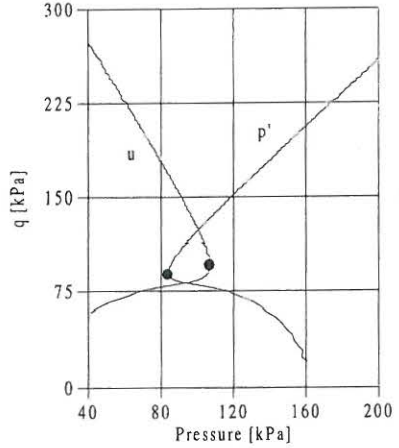


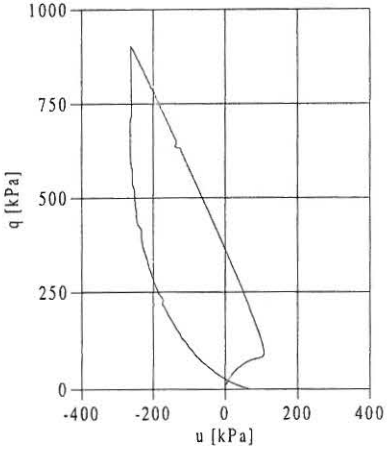
Remarks

Job: Ph.D. Project	Aalborg University
Executed: KPJ	Enclosure No. 12
Evaluated: KPJ	Approved: KPJ









Remarks

Job: Ph.D. Project	Aalborg University
Executed: KPJ	Enclosure No. 12
Evaluated: KPJ	Approved: KPJ

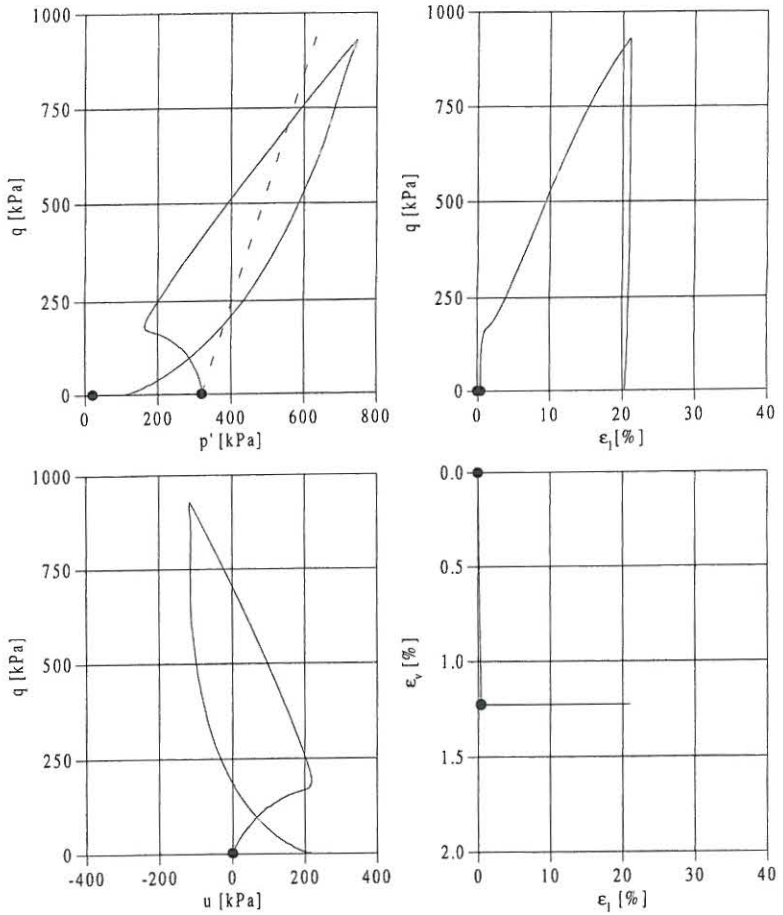
Description of soil Eastern Scheldt Sand	Triaxial Apparatus No. 2	Specimen properties	
Specimen preparation Pluviation	Calibration file Cal97107.dat	Height Diameter	71.44 mm 69.64 mm
Saturation procedure Water percolation	Date 1998-09-06	Void ratio	0.824

Test program			
	Isotropic compression, σ'_3 :	20.0 - 320	kPa
	Loading rate:	5.0 - 10.0	kPa/min
	Undrained compression Deformation rate:	3.0	% ph.

Isotropic compression			
Confining pressure	σ'_3	319.9	kPa
Axial strain	ε_1	0.39	%
Volumetric strain	ε_v	1.22	%
Void ratio	e	0.802	

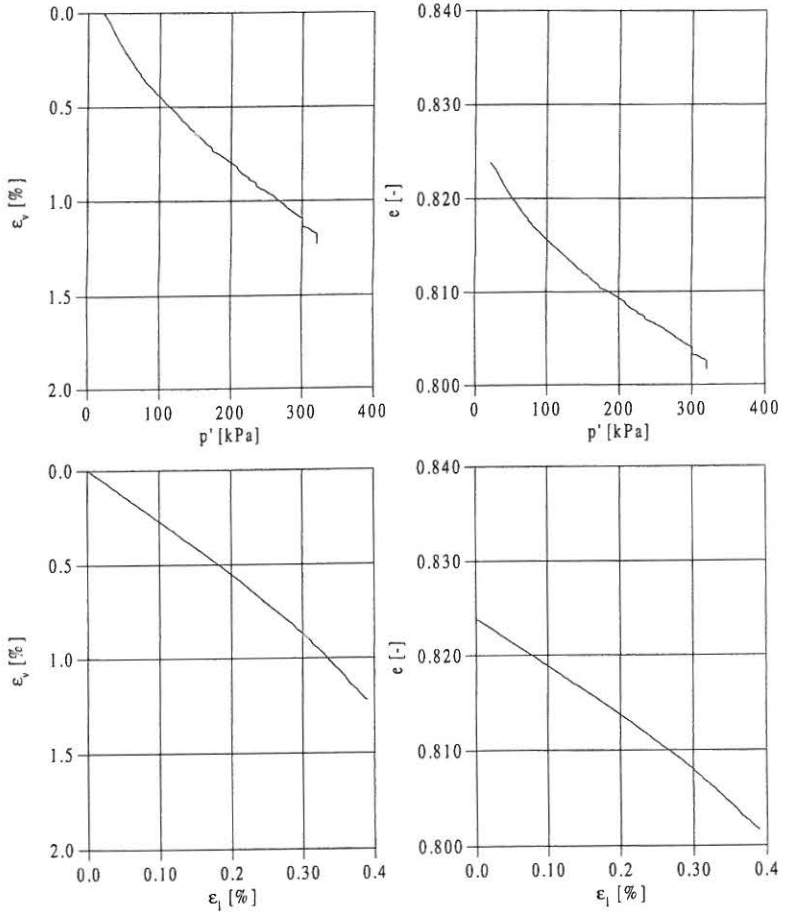
Undrained compression		Values at p'_{min}		Values at u_{max}	
Stress ratio	σ'_1/σ'_3	2.77		2.84	
Confining pressure	σ'_3	103.0	kPa	102.0	kPa
Pore pressure	u	217.1	kPa	218.1	kPa
Deviator stress	q	182.7	kPa	187.4	kPa
Mean normal stress	p'	163.9	kPa	164.5	kPa
Ratio	q / p'	1.12		1.14	
Axial strain	ε_1	1.99	%	2.17	%
Friction angle	φ'	28.0	°	28.6	°

Job: Ph.D. Project	Aalborg University
Executed: KPJ	Enclosure No. 13
Evaluated: KPJ	Approved: KPJ



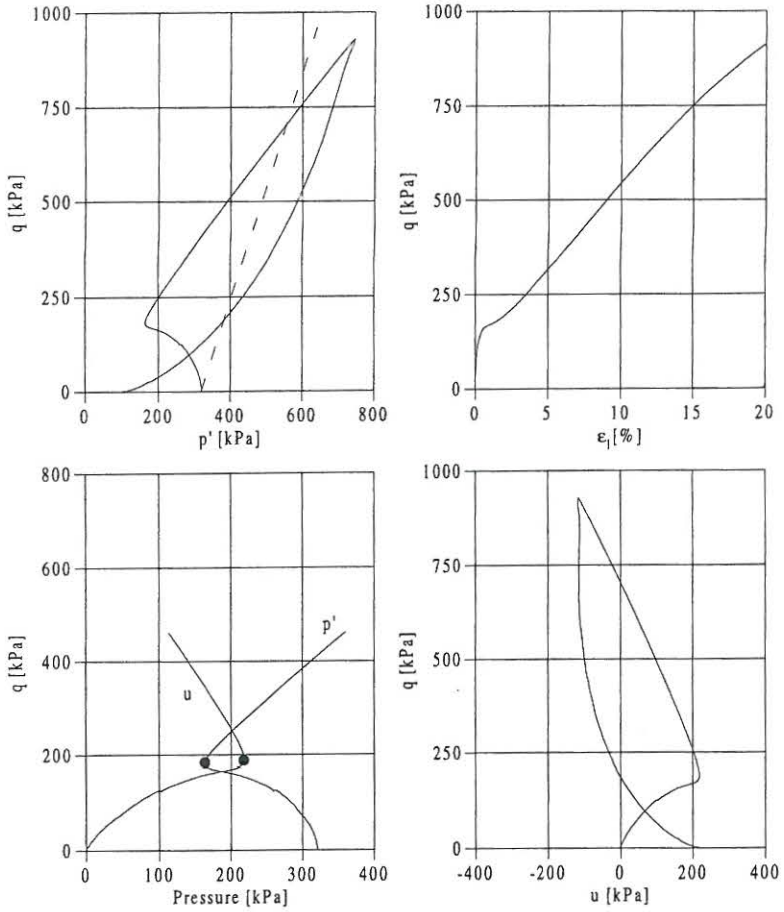
Legend
- Isotropic compression
- Undrained compression

Job: Ph.D. Project	Aalborg University
Executed: KPJ	Enclosure No. 13
Evaluated: KPJ	Approved: KPJ



Remarks

Job: Ph.D. Project	Aalborg University
Executed: KPJ	Enclosure No. 13
Evaluated: KPJ	Approved: KPJ



Remarks

Job: Ph.D. Project	Aalborg University
Executed: KPJ	Enclosure No. 13
Evaluated: KPJ	Approved: KPJ

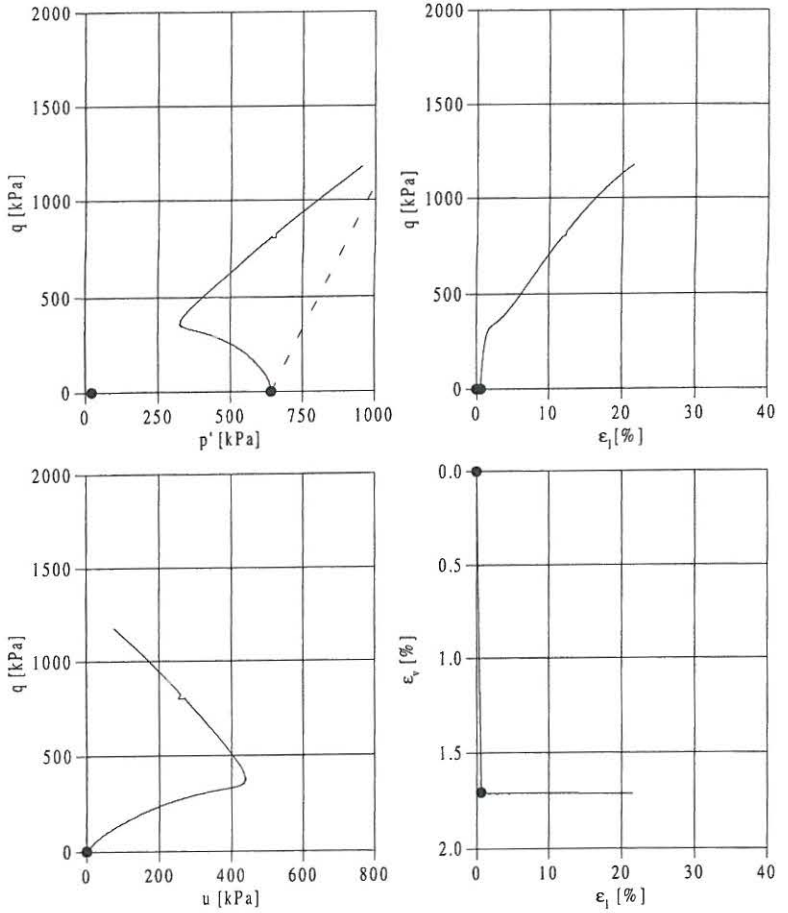
Description of soil Eastern Scheldt Sand	Triaxial Apparatus No. 2	Specimen properties	
Specimen preparation Pluviation	Calibration file Cal97107.dat	Height Diameter	71.45 mm 69.65 mm
Saturation procedure Water percolation	Date 1998.09.06	Void ratio	0.825

Test program			
	Isotropic compression, σ'_3 :	20.0 - 640.0	kPa
	Loading rate:	5.0 - 10.0	kPa/min
	Undrained compression Deformation rate:	3.0	% ph.

Isotropic compression			
Confining pressure	σ'_3	640.3	kPa
Axial strain	ε_1	0.60	%
Volumetric strain	ε_v	1.70	%
Void ratio	e	0.794	

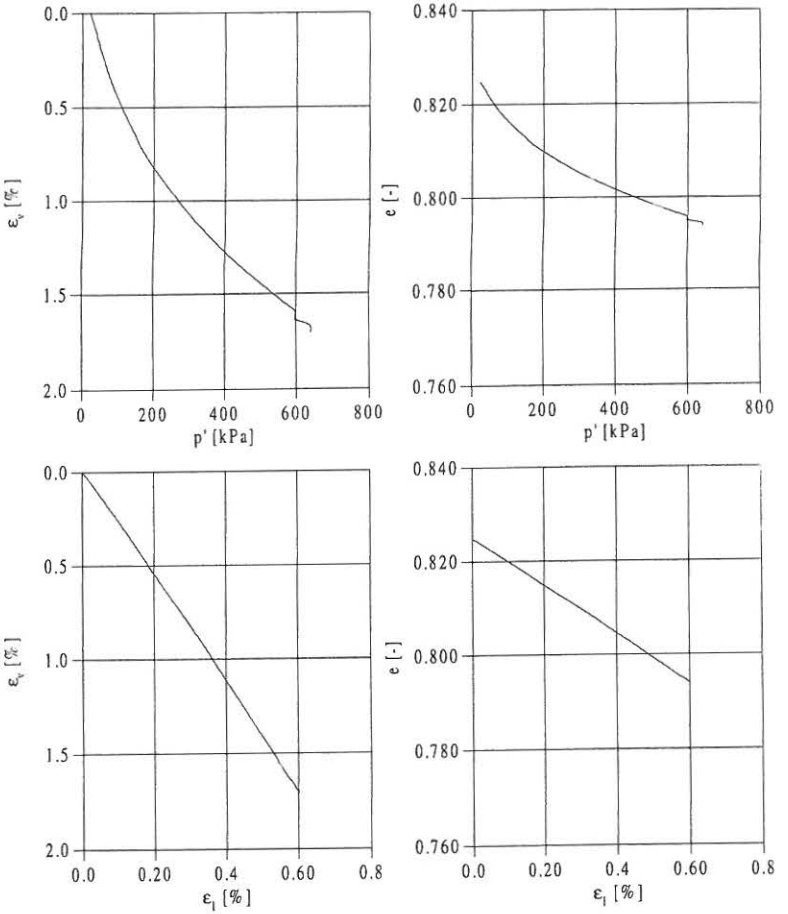
Undrained compression		Values at p'_{min}		Values at u_{max}	
Stress ratio	σ'_1/σ'_3	2.74		2.86	
Confining pressure	σ'_3	204.8	kPa	202.8	kPa
Pore pressure	u	435.4	kPa	437.4	kPa
Deviator stress	q	355.7	kPa	376.6	kPa
Mean normal stress	p'	323.4	kPa	328.3	kPa
Ratio	q / p'	1.10		1.15	
Axial strain	ε_1	3.01	%	3.53	%
Friction angle	φ'	27.7	°	28.8	°

Job: Ph.D. Project	Aalborg University
Executed: KPJ	Enclosure No. 14
Evaluated: KPJ	Approved: KPJ



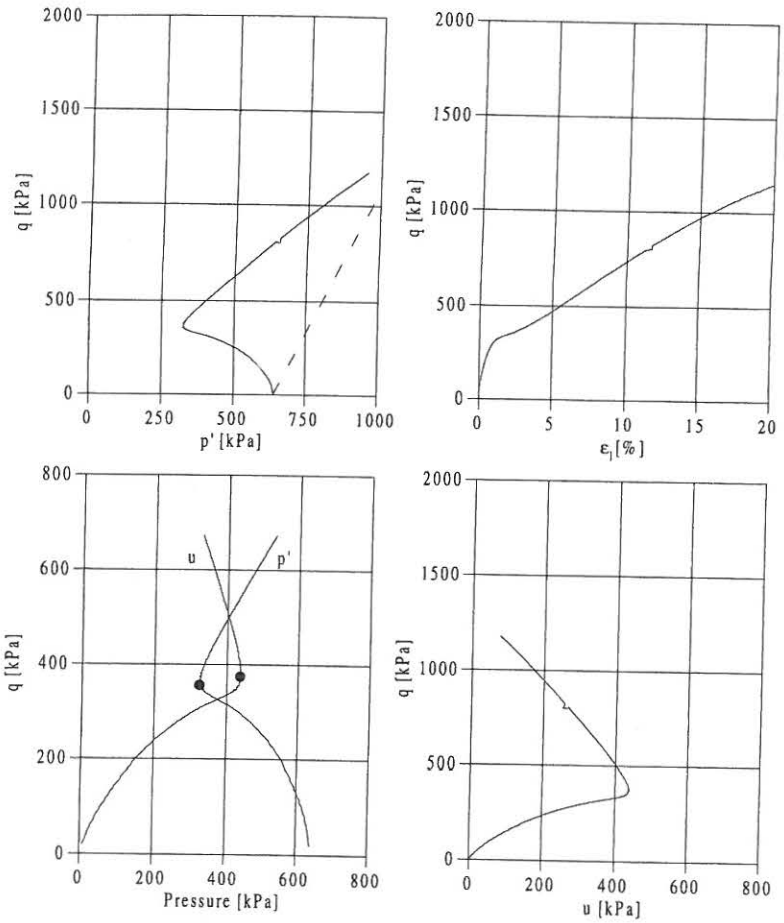
Legend
- Isotropic compression
- Undrained compression

Job: Ph.D. Project	Aalborg University
Executed: KPJ	Enclosure No. 14
Evaluated: KPJ	Approved: KPJ



Remarks

Job: Ph.D. Project	Aalborg University
Executed: KPJ	Enclosure No. 14
Evaluated: KPJ	Approved: KPJ



Remarks

Job: Ph.D. Project	Aalborg University
Executed: KPJ Evaluated: KPJ	Enclosure No. 14 Approved: KPJ

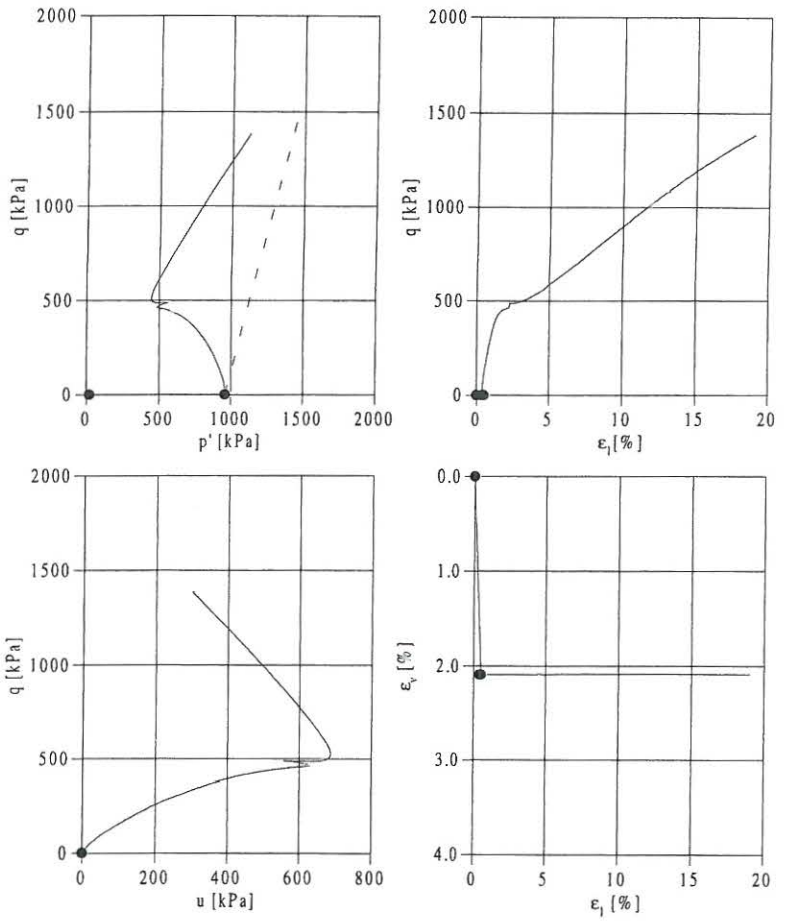
Description of soil Eastern Scheldt Sand	Triaxial Apparatus No. 2	Specimen properties	
Specimen preparation Pluviation	Calibration file Cal97107.dat	Height Diameter	71.45 mm 69.65 mm
Saturation procedure Water percolation	Date 1998-09-08	Void ratio	0.825

Test program			
	Isotropic compression, σ'_3 :	20.0 - 960.0	kPa
	Loading rate:	5.0 - 10.0	kPa/min
	Undrained compression Deformation rate:	3.0	% ph.

Isotropic compression			
Confining pressure	σ'_3	960.0	kPa
Axial strain	ε_1	0.51	%
Volumetric strain	ε_v	2.09	%
Void ratio	e	0.787	

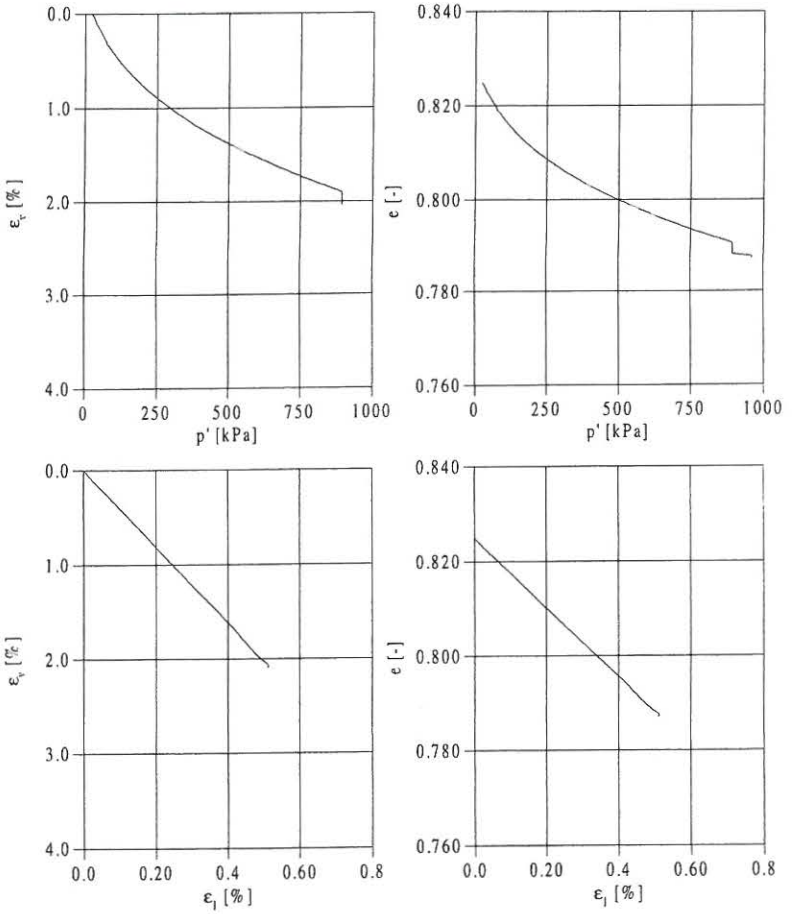
Undrained compression		Values at u_{max}	
Stress ratio	σ'_1/σ'_3	2.93	
Confining pressure	σ'_3	273.1	kPa
Pore pressure	u	686.9	kPa
Deviator stress	q	528.2	kPa
Mean normal stress	p'	449.1	kPa
Ratio	q / p'	1.18	
Axial strain	ε_1	3.92	%
Friction angle	φ'	29.5	°

Job: Ph.D. Project	Aalborg University
Executed: KPJ Evaluated: KPJ	Enclosure No. 15 Approved: KPJ



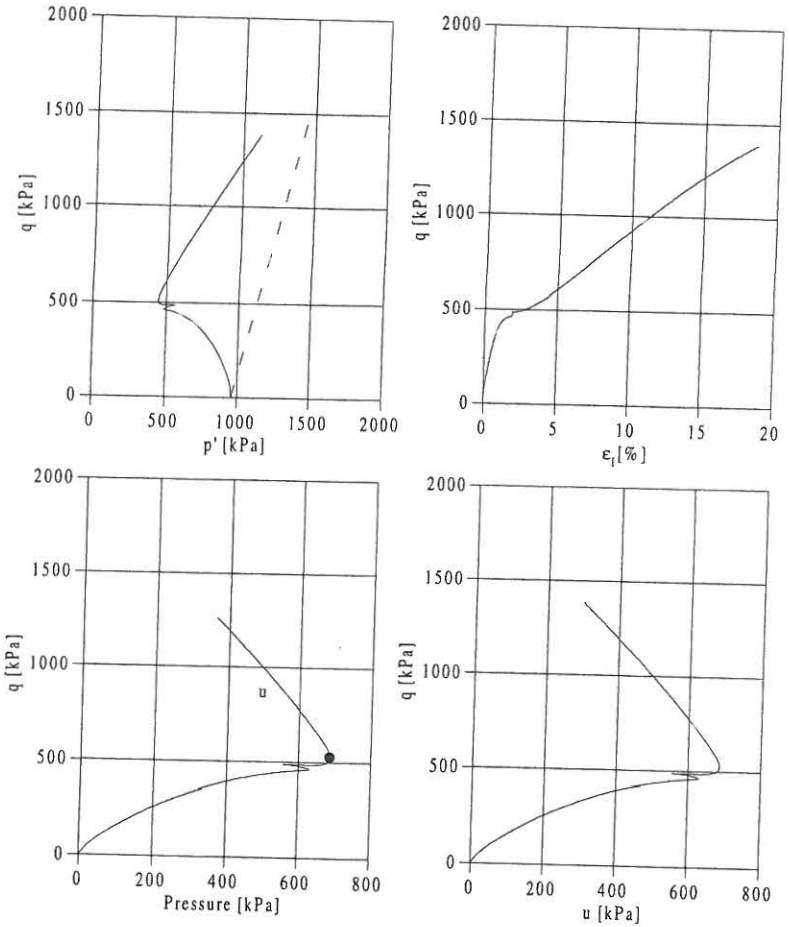
Legend
- Isotropic compression
- Undrained compression

Job: Ph.D. Project	Aalborg University
Executed: KPJ	Enclosure No. 15
Evaluated: KPJ	Approved: KPJ



Remarks

Job: Ph.D. Project	Aalborg University
Executed: KPJ	Enclosure No. 15
Evaluated: KPJ	Approved: KPJ



Remarks

Job: Ph.D. Project	Aalborg University
Executed: KPJ Evaluated: KPJ	Enclosure No. 15 Approved: KPJ

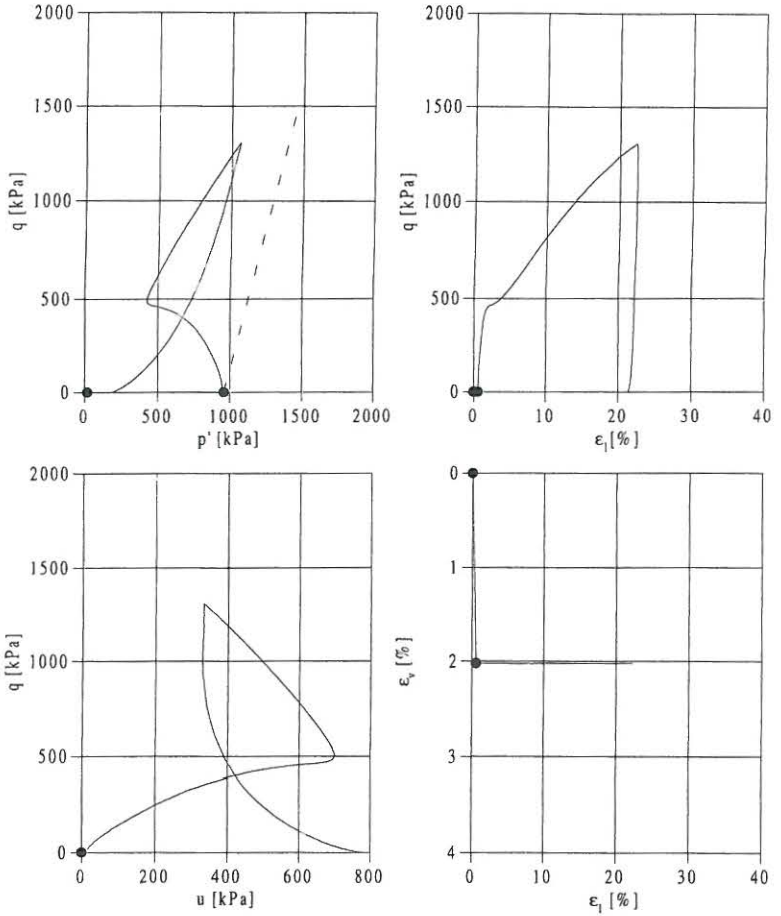
Description of soil Eastern Scheldt Sand	Triaxial Apparatus No. 2	Specimen properties	
Specimen preparation Pluviation	Calibration file Cal97107.dat	Height Diameter	71.45 mm 69.65 mm
Saturation procedure Water percolation	Date 1998-09-24	Void ratio	0.825

Test program			
	Isotropic compression, σ'_3 :	20.0 - 960.0	kPa
	Loading rate:	5.0 - 10.0	kPa/min
	Undrained compression Deformation rate:	3.0	% ph.

Isotropic compression			
Confining pressure	σ'_3	960.0	kPa
Axial strain	ε_1	0.59	%
Volumetric strain	ε_v	2.02	%
Void ratio	e	0.788	

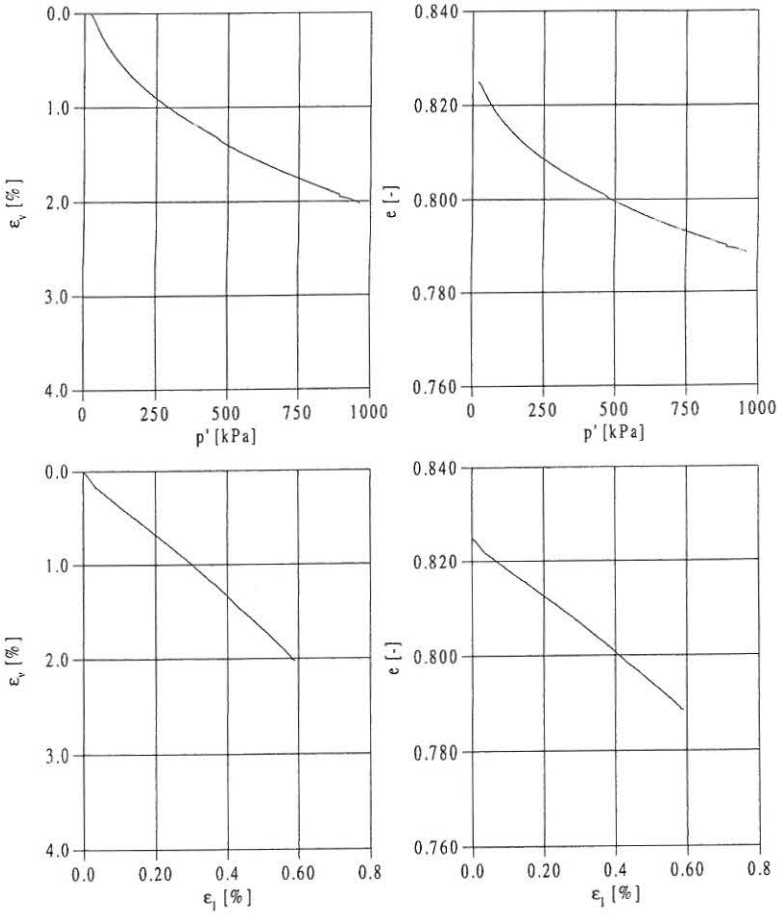
Undrained compression		Values at p'_{min}		Values at u_{max}	
Stress ratio	σ'_1/σ'_3	2.86		2.94	
Confining pressure	σ'_3	263.3	kPa	260.8	kPa
Pore pressure	u	696.7	kPa	699.2	kPa
Deviator stress	q	489.3	kPa	505.5	kPa
Mean normal stress	p'	426.4	kPa	429.3	kPa
Ratio	q / p'	1.15		1.18	
Axial strain	ε_1	3.50	%	3.94	%
Friction angle	φ'	28.8	°	29.5	°

Job: Ph.D. Project	Aalborg University
Executed: KPJ Evaluated: KPJ	Enclosure No. 16 Approved: KPJ



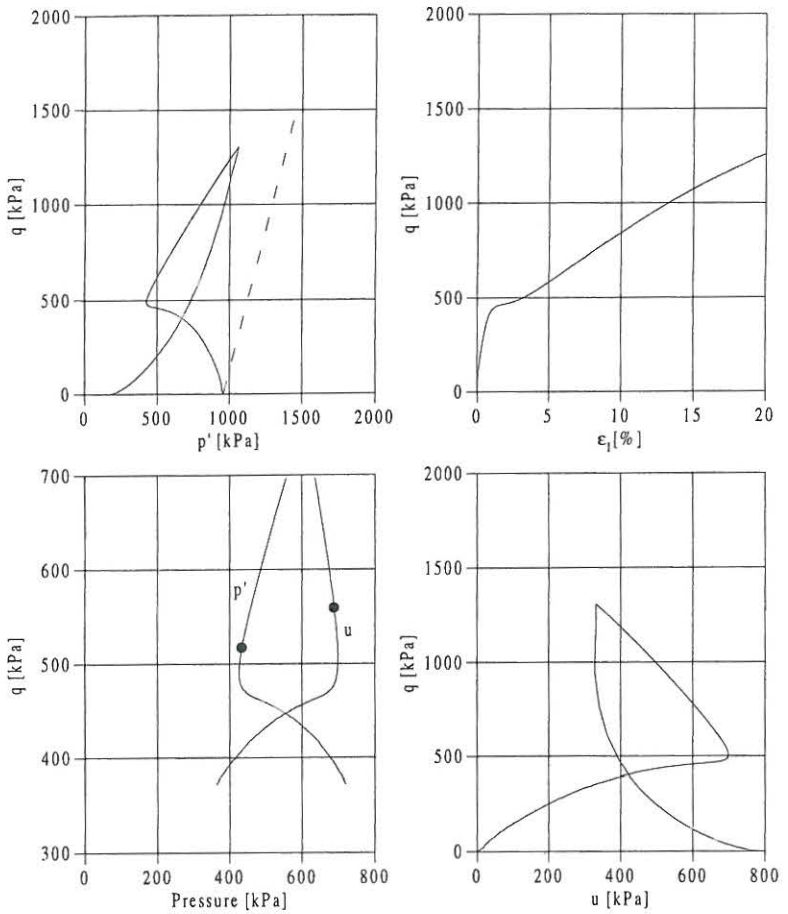
Legend
- Isotropic compression
- Undrained compression

Job: Ph.D. Project	Aalborg University
Executed: KPJ	Enclosure No. 16
Evaluated: KPJ	Approved: KPJ



Remarks

Job: Ph.D. Project	Aalborg University
Executed: KPJ	Enclosure No. 16
Evaluated: KPJ	Approved: KPJ



Remarks

Job: Ph.D. Project	Aalborg University
Executed: KPJ	Enclosure No. 16
Evaluated: KPJ	Approved: KPJ

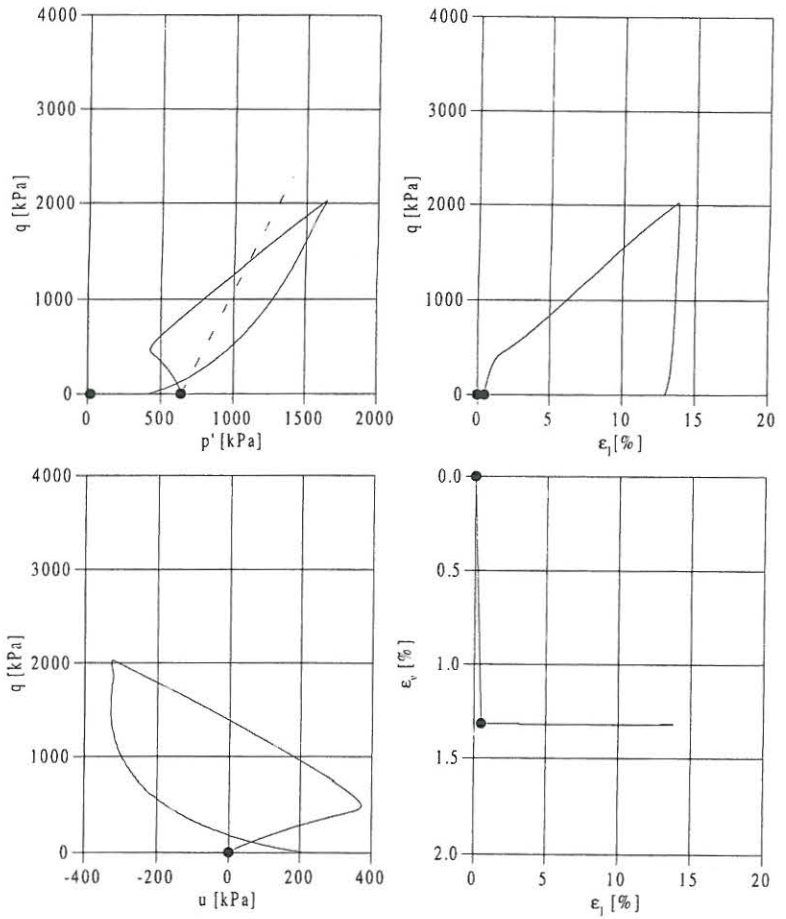
Description of soil	Triaxial Apparatus No. 2	Specimen properties	
Eastern Scheldt Sand			
Specimen preparation	Calibration file	Height	71.44 mm
Pluviation	Cal97107.dat	Diameter	69.64 mm
Saturation procedure	Date	Void ratio	0.726
Water percolation	1998-09-13		

Test program			
	Isotropic compression, σ_3' :	20.0 - 640.0	kPa
	Loading rate:	5.0 - 10.0	kPa/min
	Undrained compression Deformation rate:	3.0	% ph.

Isotropic compression			
Confining pressure	σ_3'	640.0	kPa
Axial strain	ε_1	0.51	%
Volumetric strain	ε_v	1.32	%
Void ratio	e	0.703	

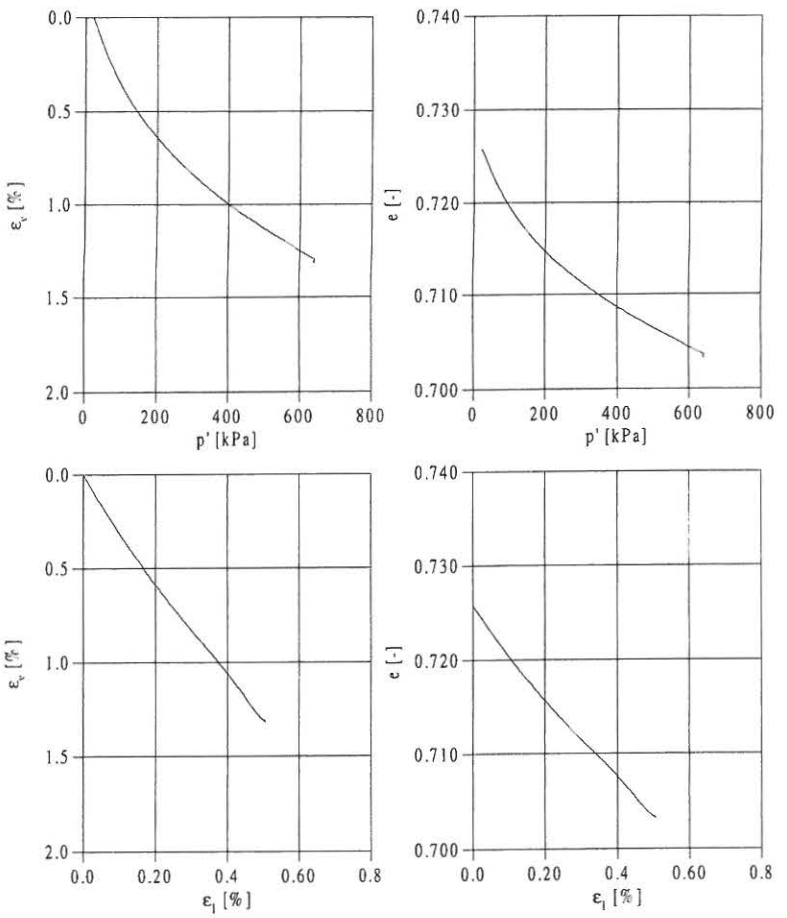
Undrained compression		Values at p'_{min}		Values at u_{max}	
Stress ratio	σ_1'/σ_3'	2.70		2.83	
Confining pressure	σ_3'	274.1	kPa	268.5	kPa
Pore pressure	u	365.9	kPa	371.4	kPa
Deviator stress	q	465.7	kPa	492.6	kPa
Mean normal stress	p'	429.3	kPa	432.7	kPa
Ratio	q / p'	1.09		1.14	
Axial strain	ε_1	1.93	%	2.22	%
Friction angle	φ'	27.3	°	28.6	°

Job: Ph.D. Project	Aalborg University
Executed: KPJ	Enclosure No. 17
Evaluated: KPJ	Approved: KPJ



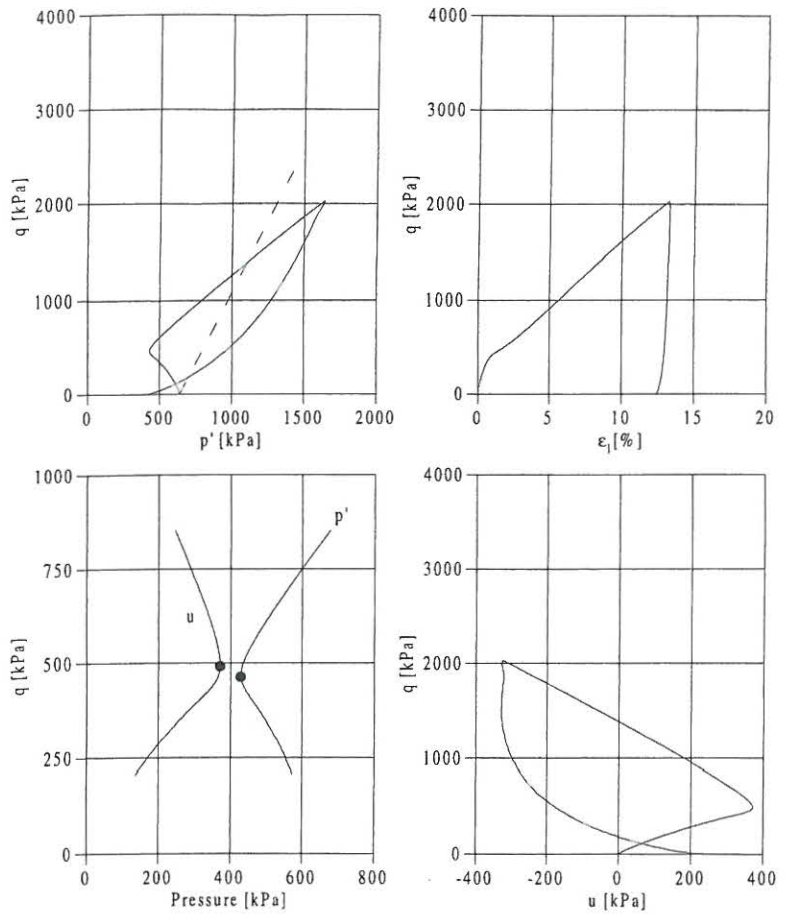
Legend
- Isotropic compression
- Undrained compression

Job: Ph.D. Project	Aalborg University
Executed: KPJ	Enclosure No. 17
Evaluated: KPJ	Approved: KPJ



Remarks

Job: Ph.D. Project	Aalborg University
Executed: KPJ	Enclosure No. 17
Evaluated: KPJ	Approved: KPJ



Remarks

Job: Ph.D. Project	Aalborg University
Executed: KPJ	Enclosure No. 17
Evaluated: KPJ	Approved: KPJ

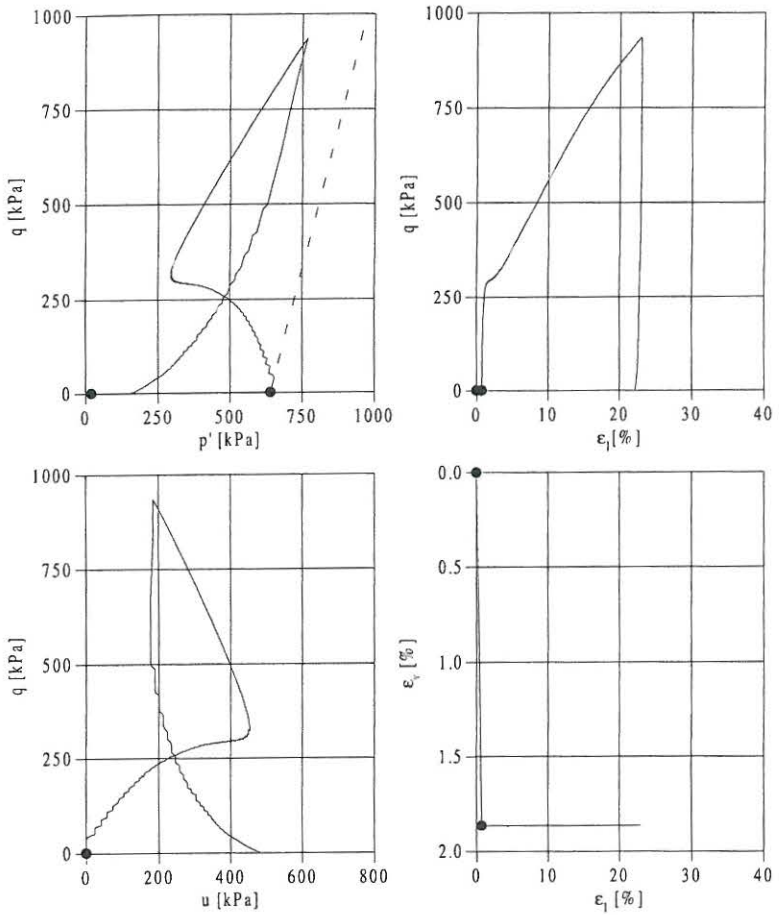
Description of soil	Triaxial Apparatus No. 2	Specimen properties	
Eastern Scheldt Sand			
Specimen preparation	Calibration file	Height	71.43 mm
Pluviation	Cal97107.dat	Diameter	69.63 mm
Saturation procedure	Date	Void ratio	0.881
Water percolation	1998-09-18		

Test program			
	Isotropic compression, σ'_3 :	20.0 - 640.0	kPa
	Loading rate:	5.0 - 10.0	kPa/min
	Undrained compression Deformation rate:	3.0	% ph.

Isotropic compression			
Confining pressure	σ'_3	640.0	kPa
Axial strain	ε_1	0.73	%
Volumetric strain	ε_v	1.86	%
Void ratio	e	0.846	

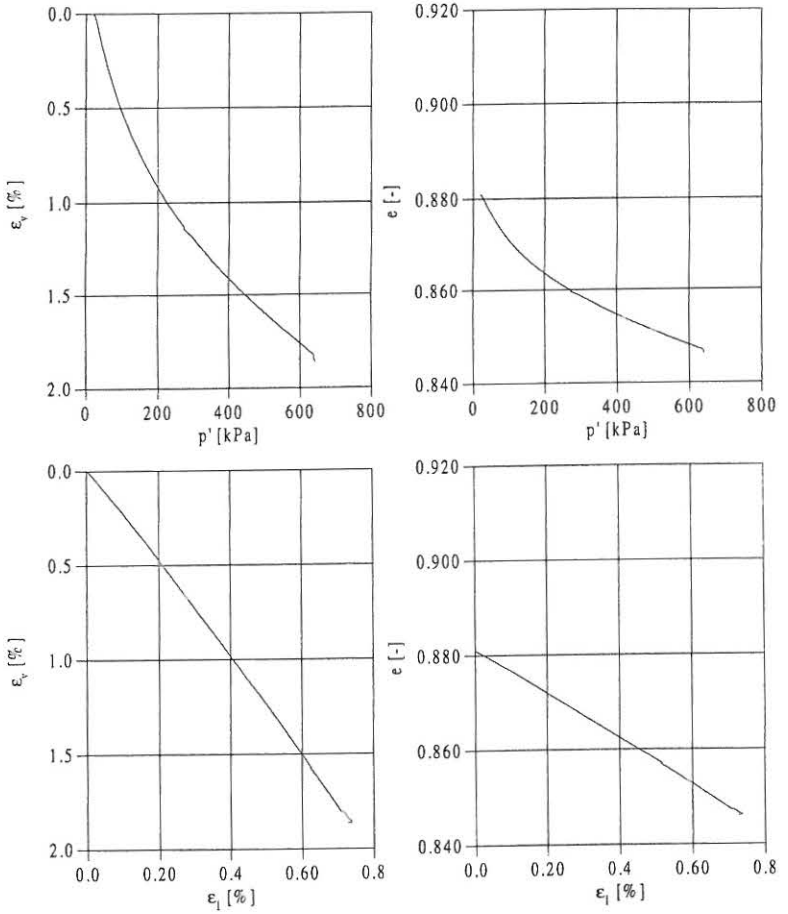
Undrained compression		Values at p'_{min}		Values at u_{max}	
Stress ratio	σ'_1/σ'_3	2.65		2.75	
Confining pressure	σ'_3	188.8	kPa	185.6	kPa
Pore pressure	u	451.1	kPa	454.3	kPa
Deviator stress	q	311.0	kPa	325.1	kPa
Mean normal stress	p'	292.5	kPa	293.9	kPa
Ratio	q / p'	1.06		1.11	
Axial strain	ε_1	2.91	%	3.41	%
Friction angle	φ'	26.9	°	27.8	°

Job: Ph.D. Project	Aalborg University
Executed: KPJ	Enclosure No. 18
Evaluated: KPJ	Approved: KPJ



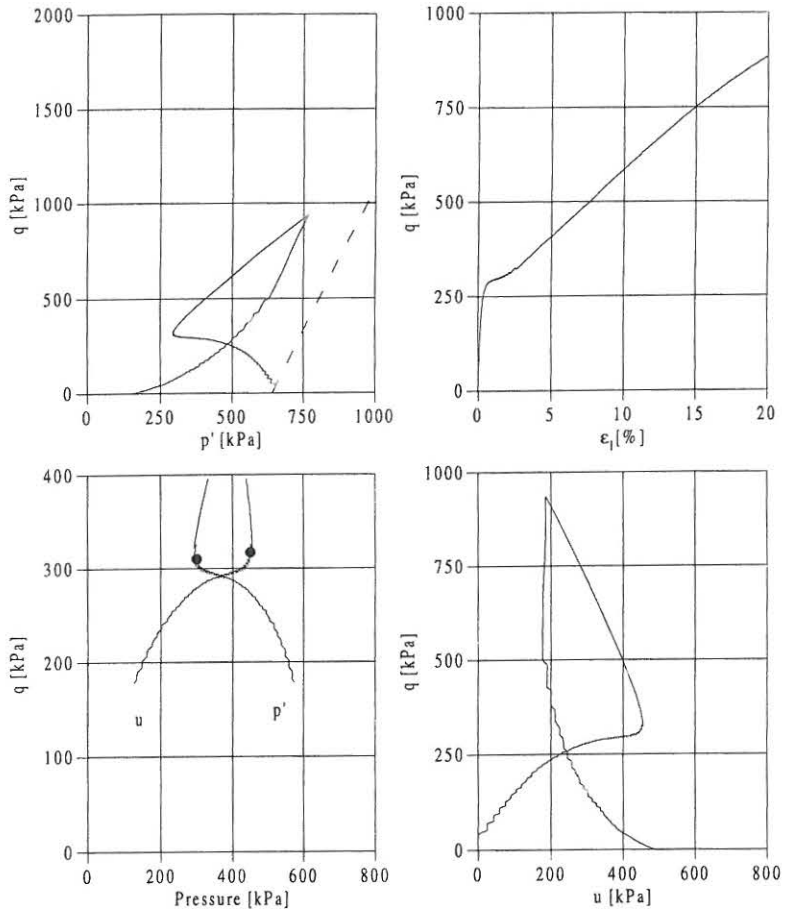
Legend
- Isotropic compression
- Undrained compression

Job: Ph.D. Project	Aalborg University
Executed: KPJ	Enclosure No. 18
Evaluated: KPJ	Approved: KPJ



Remarks

Job: Ph.D. Project	Aalborg University
Executed: KPJ	Enclosure No. 18
Evaluated: KPJ	Approved: KPJ



Remarks

Job: Ph.D. Project	Aalborg University
Executed: KPJ	Enclosure No. 18
Evaluated: KPJ	Approved: KPJ

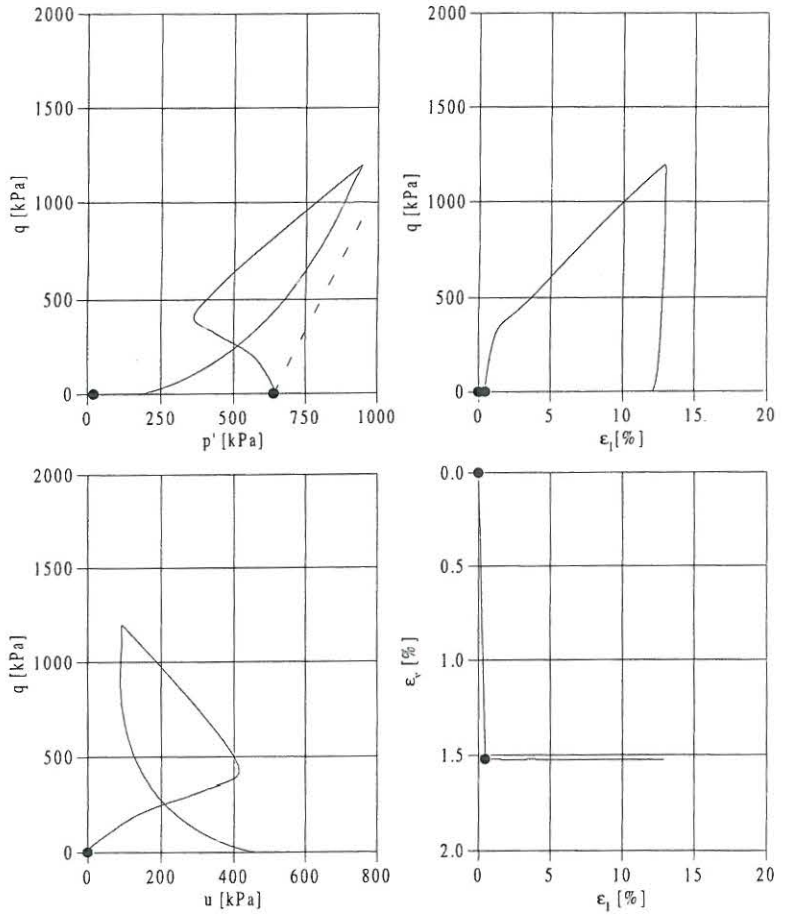
Description of soil Eastern Scheldt Sand	Triaxial Apparatus No. 2	Specimen properties	
Specimen preparation Pluviation	Calibration file Cal97107.dat	Height Diameter	71.35 mm 69.55 mm
Saturation procedure Water percolation	Date 1998-09-16	Void ratio	0.770

Test program			
	Isotropic compression, σ'_3 :	20.0 - 640.0	kPa
	Loading rate:	5.0 - 10.0	kPa/min
	Undrained compression Deformation rate:	3.0	% ph.

Isotropic compression			
Confining pressure	σ'_3	640.0	kPa
Axial strain	ε_1	0.47	%
Volumetric strain	ε_v	1.52	%
Void ratio	e	0.744	

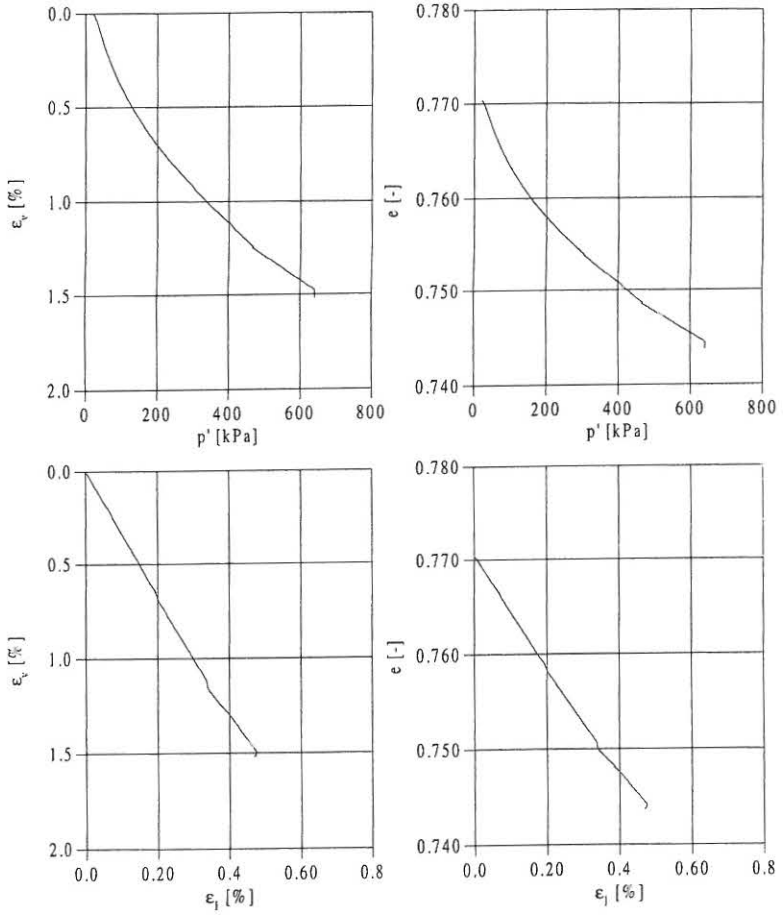
Undrained compression		Values at p'_{min}		Values at u_{max}	
Stress ratio	σ'_1/σ'_3	2.77		2.90	
Confining pressure	σ'_3	227.8	kPa	223.9	kPa
Pore pressure	u	411.1	kPa	414.9	kPa
Deviator stress	q	403.7	kPa	426.3	kPa
Mean normal stress	p'	362.3	kPa	366.0	kPa
Ratio	q / p'	1.11		1.17	
Axial strain	ε_1	2.29	%	2.65	%
Friction angle	φ'	28.0	°	29.2	°

Job: Ph.D. Project	Aalborg University
Executed: KPJ	Enclosure No. 19
Evaluated: KPJ	Approved: KPJ



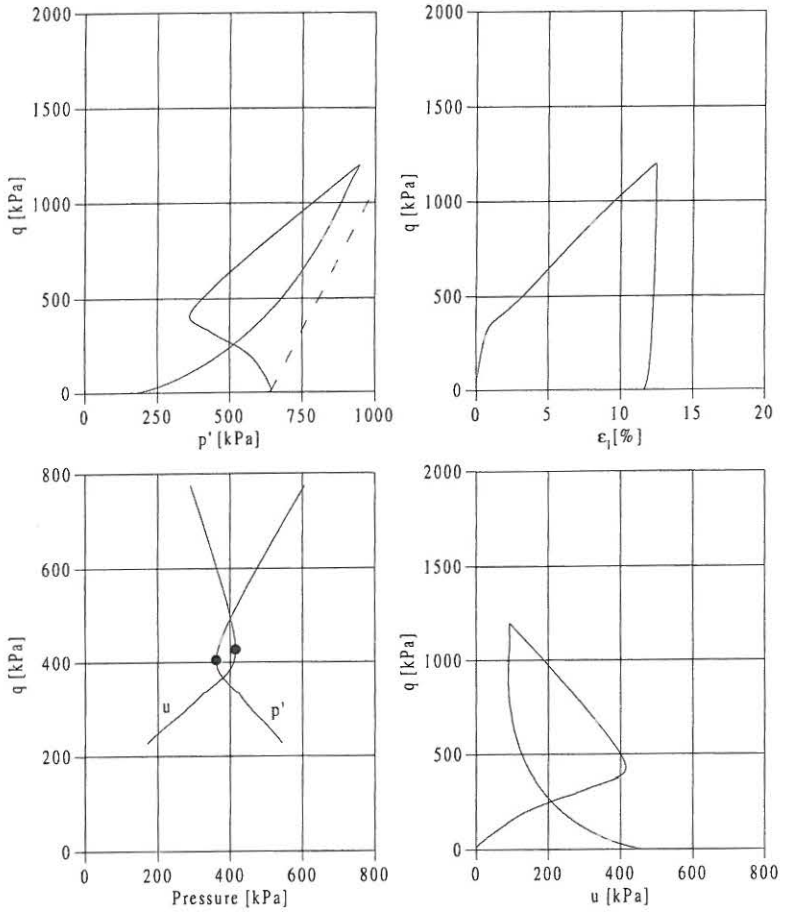
Legend
- Isotropic compression
- Undrained compression

Job: Ph.D. Project	Aalborg University
Executed: KPJ	Enclosure No. 19
Evaluated: KPJ	Approved: KPJ



Remarks

Job: Ph.D. Project	Aalborg University
Executed: KPJ	Enclosure No. 19
Evaluated: KPJ	Approved: KPJ



Remarks

Job: Ph.D. Project	Aalborg University
Executed: KPJ	Enclosure No. 19
Evaluated: KPJ	Approved: KPJ

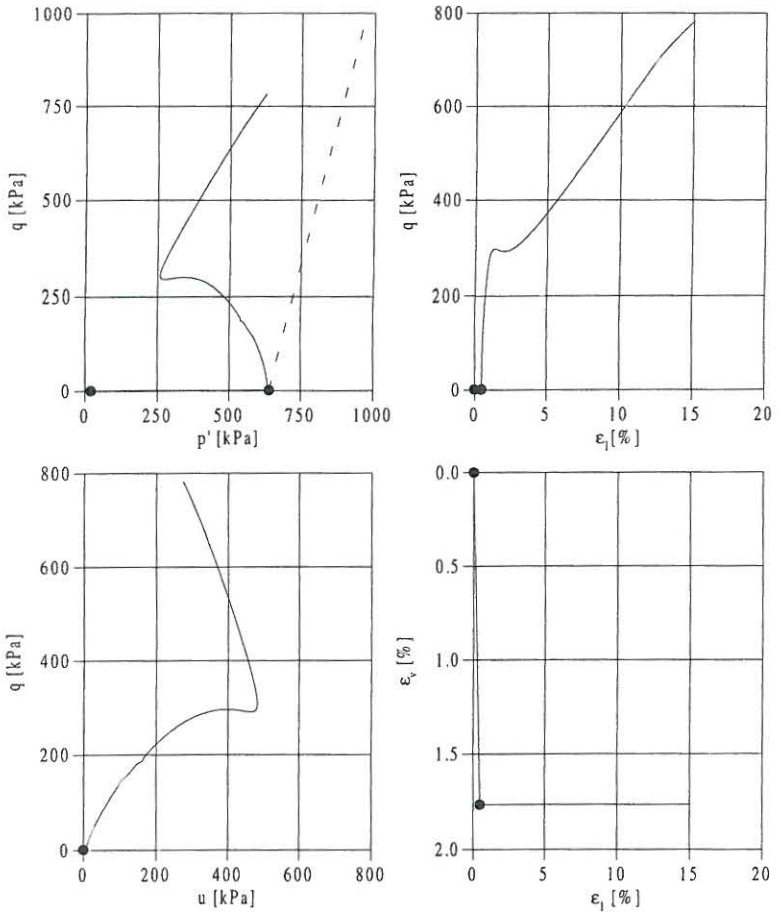
Description of soil Eastern Scheldt Sand	Triaxial Apparatus No. 2	Specimen properties	
Specimen preparation Pluviation	Calibration file Cal97108.dat	Height Diameter	139.50 mm 69.35 mm
Saturation procedure Water percolation	Date 1998-09-20	Void ratio	0.825

Test program			
	Isotropic compression, σ'_3 :	20.0 - 640.0	kPa
	Loading rate:	5.0 - 10.0	kPa/min
	Undrained compression Deformation rate:	3.0	% ph.

Isotropic compression			
Confining pressure	σ'_3	640.0	kPa
Axial strain	ε_1	0.47	%
Volumetric strain	ε_v	1.76	%
Void ratio	e	0.793	

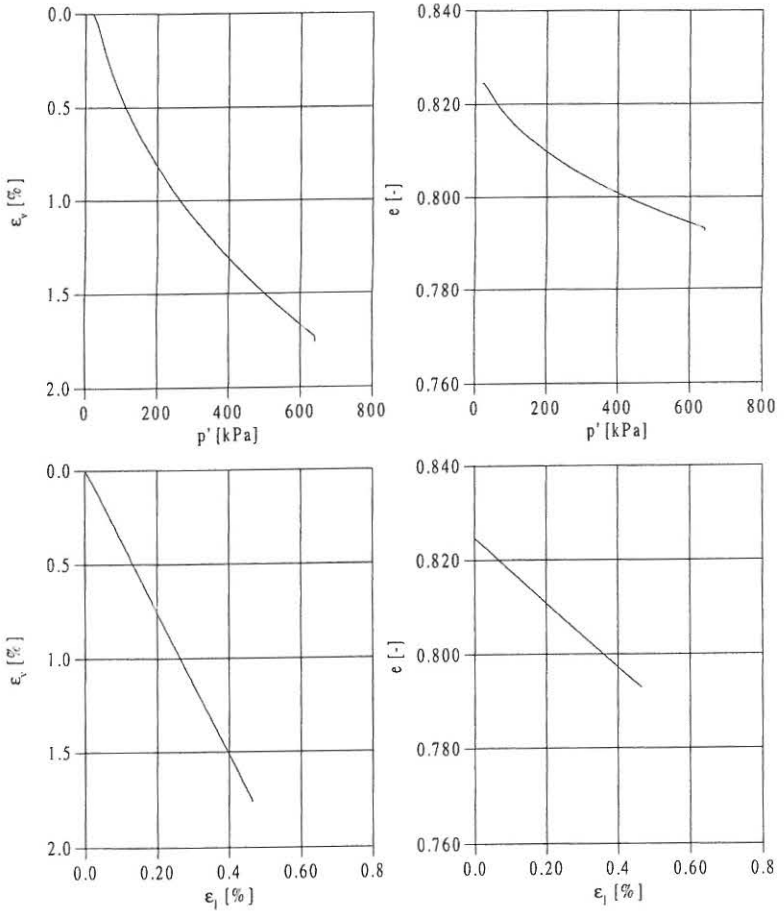
Undrained compression		Values at p'_{min}		Values at u_{max}	
Stress ratio	σ'_1/σ'_3	2.90		2.96	
Confining pressure	σ'_3	158.0	kPa	157.2	kPa
Pore pressure	u	482.0	kPa	482.8	kPa
Deviator stress	q	300.6	kPa	307.5	kPa
Mean normal stress	p'	258.2	kPa	259.7	kPa
Ratio	q / p'	1.16		1.18	
Axial strain	ε_1	2.82	%	3.09	%
Friction angle	φ'	29.2	°	29.6	°

Job: Ph.D. Project	Aalborg University
Executed: KPJ	Enclosure No. 20
Evaluated: KPJ	Approved: KPJ



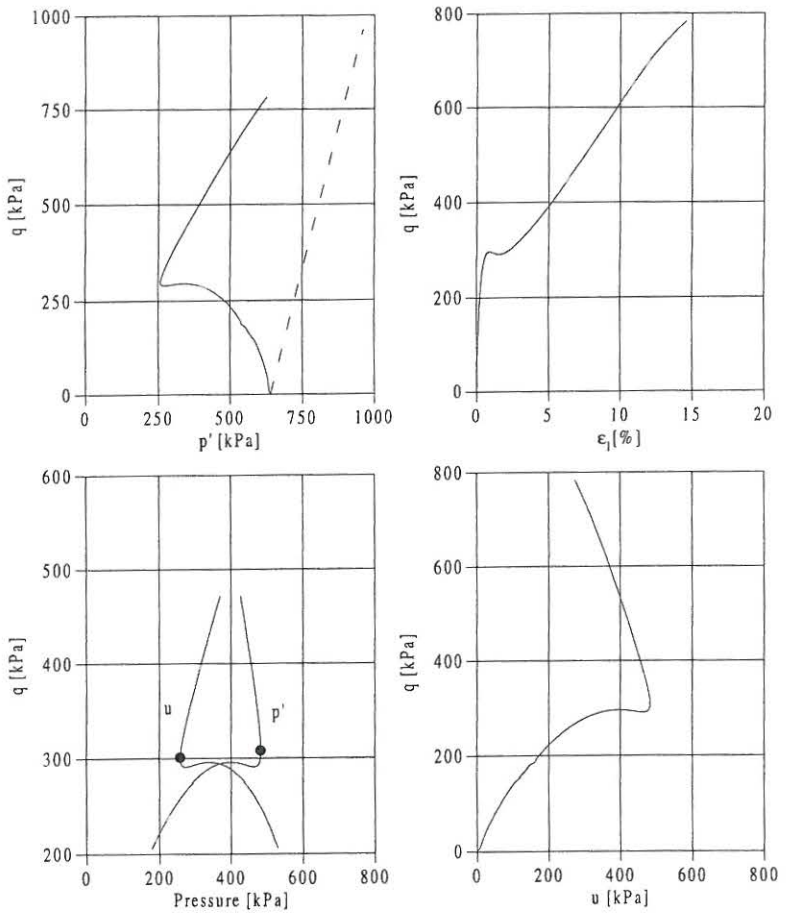
Legend
- Isotropic compression
- Undrained compression

Job: Ph.D. Project	Aalborg University
Executed: KPJ	Enclosure No. 20
Evaluated: KPJ	Approved: KPJ



Remarks

Job: Ph.D. Project	Aalborg University
Executed: KPJ	Enclosure No. 20
Evaluated: KPJ	Approved: KPJ



Remarks

Job: Ph.D. Project	Aalborg University
Executed: KPJ	Enclosure No. 20
Evaluated: KPJ	Approved: KPJ

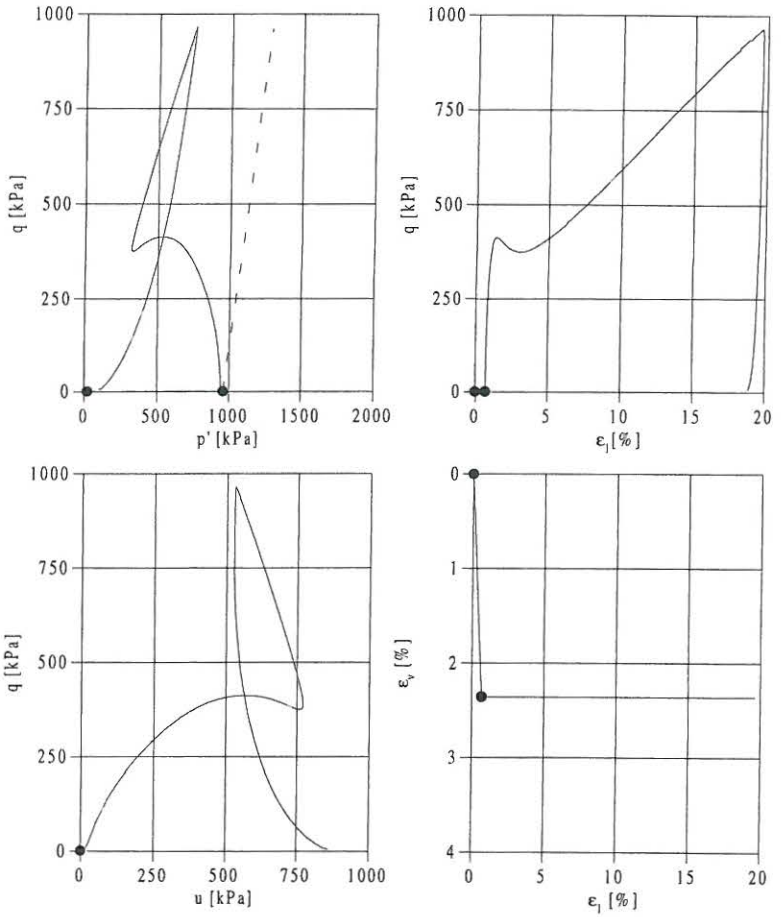
Description of soil	Triaxial Apparatus No. 2	Specimen properties	
Eastern Scheldt Sand			
Specimen preparation	Calibration file	Height	139.53 mm
Pluviation	Cal97108.dat	Diameter	69.37 mm
Saturation procedure	Date	Void ratio	0.826
Water percolation	1998-09-21		

Test program	Isotropic compression, σ'_3 :	20.0 - 960.0	kPa
	Loading rate:	5.0 - 10.0	kPa/min
	Undrained compression Deformation rate:	3.0	% ph.

Isotropic compression			
Confining pressure	σ'_3	959.9	kPa
Axial strain	ε_1	0.68	%
Volumetric strain	ε_v	2.36	%
Void ratio	e	0.783	

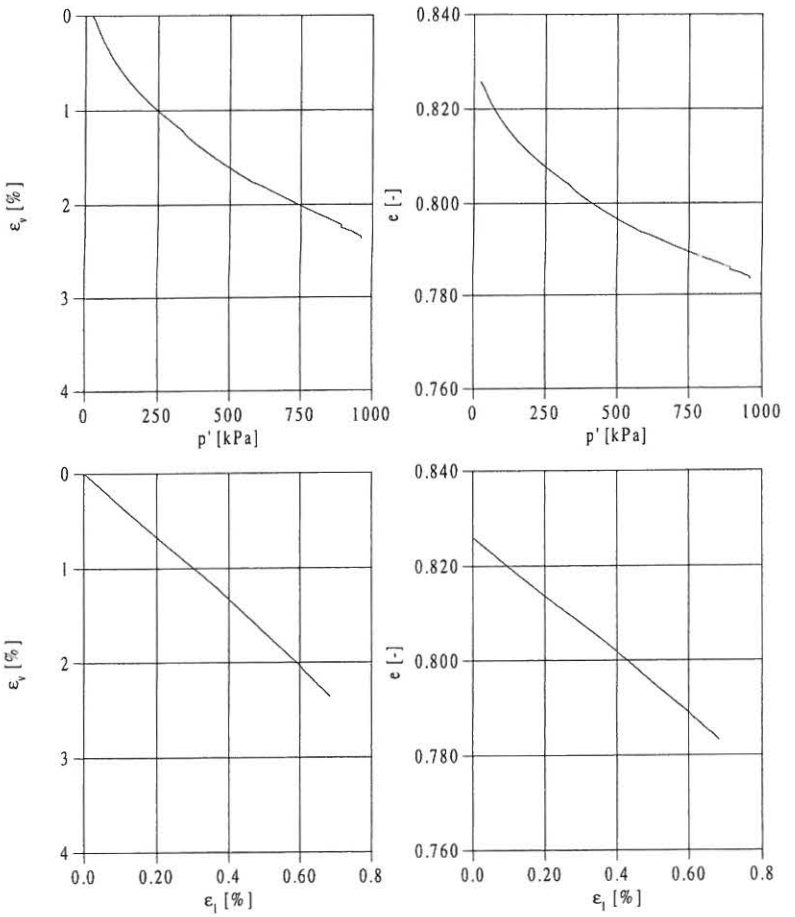
Undrained compression		Values at p'_{min}		Values at u_{max}	
Stress ratio	σ'_1/σ'_3	3.00		3.05	
Confining pressure	σ'_3	190.5	kPa	189.2	kPa
Pore pressure	u	769.4	kPa	770.7	kPa
Deviator stress	q	381.4	kPa	388.3	kPa
Mean normal stress	p'	317.6	kPa	318.6	kPa
Ratio	q / p'	1.20		1.22	
Axial strain	ε_1	3.74	%	4.11	%
Friction angle	φ'	30.0	°	30.4	°

Job: Ph.D. Project	Aalborg University
Executed: KPJ	Enclosure No. 21
Evaluated: KPJ	Approved: KPJ



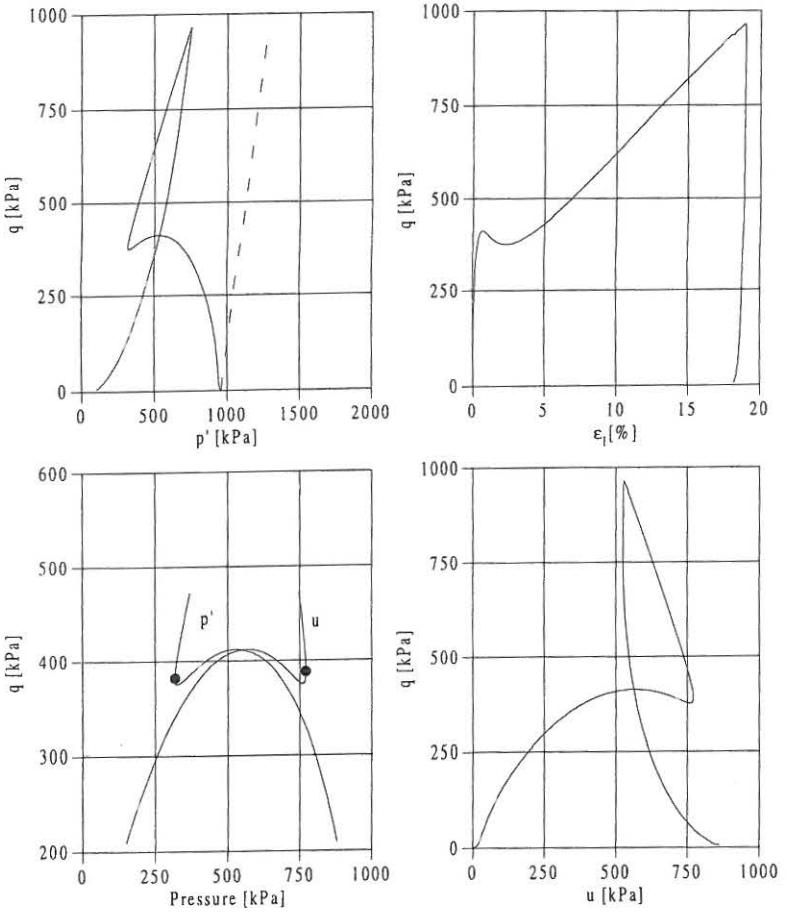
Legend	
●	Isotropic compression
——	Undrained compression

Job: Ph.D. Project	Aalborg University
Executed: KPJ	Enclosure No. 21
Evaluated: KPJ	Approved: KPJ



Remarks

Job: Ph.D. Project	Aalborg University
Executed: KPJ	Enclosure No. 21
Evaluated: KPJ	Approved: KPJ



Remarks

Job: Ph.D. Project	Aalborg University
Executed: KPJ	Enclosure No. 21
Evaluated: KPJ	Approved: KPJ

AGEP: Laboratory testing papers

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AGEP: Laboratory testing papers

15 Steenfelt, J.S., Ibsen, L.B. (1997). Konsolideringsforsøg på moræneler. DORAS - Fredericia Terminal (Oedometer tests on clay till; in Danish). *AAU Geotechnical Engineering Papers*, ISSN 1398-6465 R9705.

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